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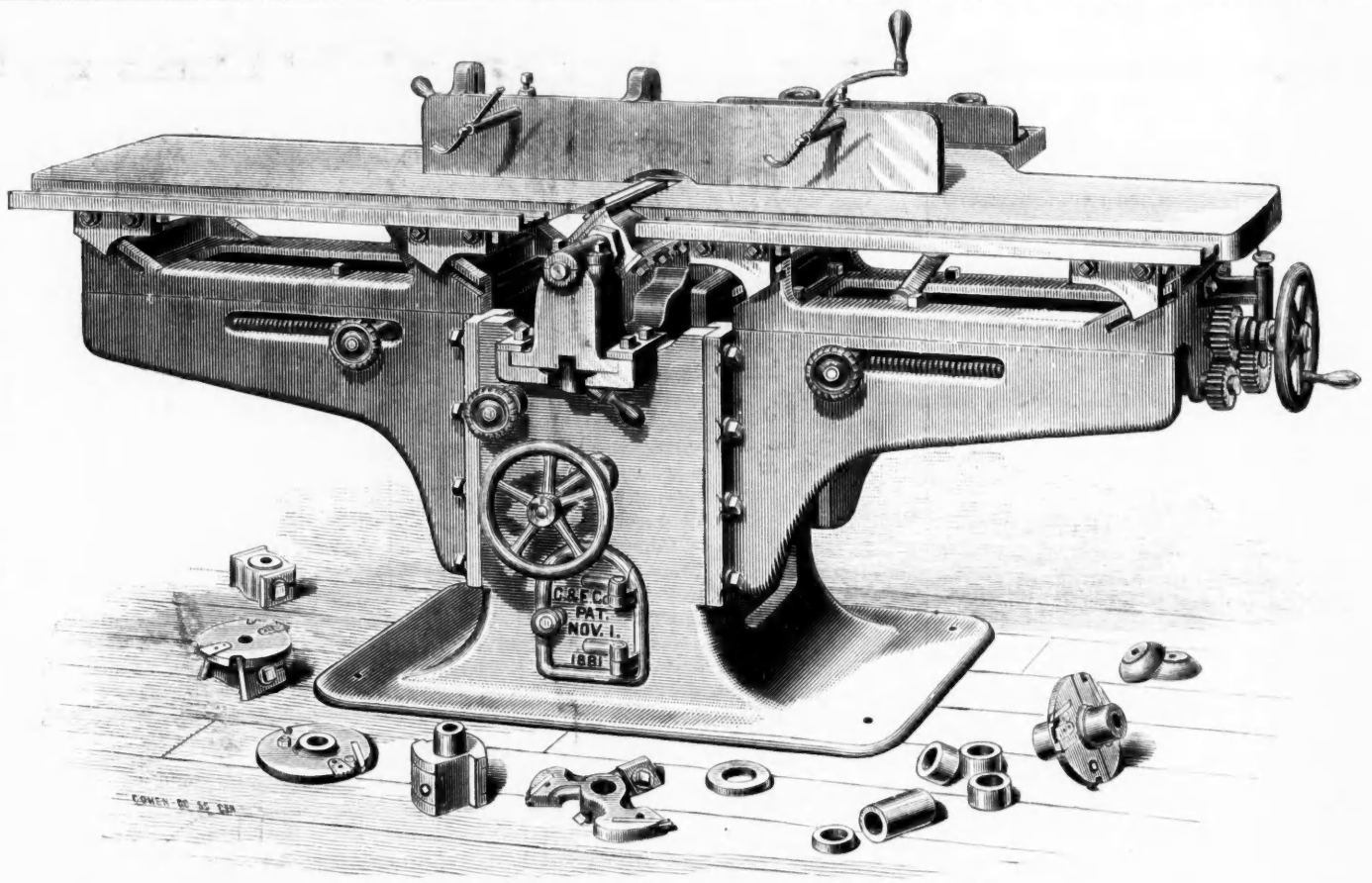
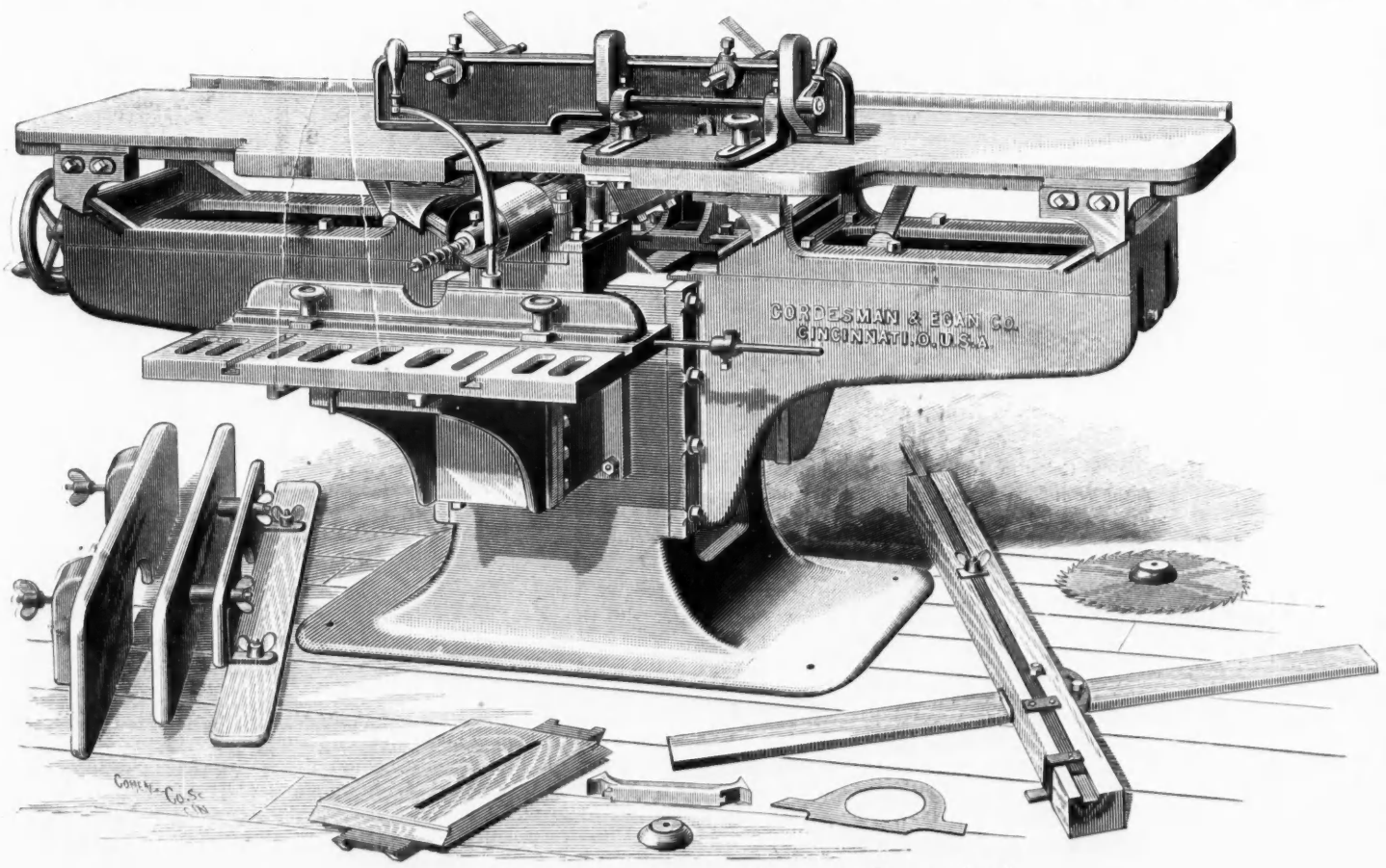
Improved Universal Woodworker.

The cuts on this page represent a new wood worker recently introduced by the Cordesman & Egan Company, of Cincinnati, O., for which important improvements are claimed. This class of machines has become a necessity in woodworking establishments, from the great range and variety of work which they are capable of doing. From the cuts and description it will be seen that this machine is convenient in its parts, the adjustments being such as to give the operator complete control of the entire machine and require very little of his time to set and adjust the various parts. For a description of the various parts of the machine, its capacity, etc., we refer to the following from the company's new catalogue:

The frame of the machine is cored out and cast all in one piece, and is very heavily braced, widening very much at the base, which makes a solid bearing for the machine to stand on, and prevents vibration of the mandrel and heads when running at the highest speed. One particular point is the patent connected and movable bearings, which are adjustable laterally across the machine in square-gibbed slides, by means of the small hand-wheel in front. Thus, when the operator has his fence set for doing work,



IMPROVED UNIVERSAL WOODWORKER. (PLANER AND JOINTER SIDE.)



IMPROVED UNIVERSAL WOODWORKER. (BORING AND ROUTING SIDE.)

he can adjust his head to a positive certainty to the line wanted—a point which is much appreciated by all classes of wood-workers. The outside bearing can be instantly removed by loosening one hand-bolt, thus giving free access to the head.

The spindle is of the best steel, is very heavy, and runs in self-oiling bearings, lined with babbitt metal; and all cutter-heads are made of material suitable for the highest speed.

The tables on each side of cutter-head are adjusted simultaneously from the working end of the machine, and move to the circle of the head. This will be found very convenient where both tables require to be adjusted and kept to their respective height. Either table can be raised or lowered at the will of the operator, with the one handle, and both tables can be raised and lowered by the same contrivance. This will be found of great advantage. The inclines on which the tables raise and lower are very perfect and very quickly adjusted. Both tables can be moved back clear from the head, giving free access to the mandrel to put on any tool or head needed, and can be moved up again without disarranging the tables. The tables also have a vertical adjustment, by means of the large hand-wheel shown on the front of the machine. This adjustment will be found very advantageous in using gaining heads, rabbetting heads, saws, etc., where both tables want to be raised simultaneously so as to keep the same level.

The gaining frame is of superior construction, and something new and novel. The paneling frame, saw boards, throat irons for tenoning, etc., or cutter-heads complete for different kinds of work, can all be furnished with the machine when required.

The patent fence, by loosening one clamp-bolt, can be set to any angle desired, and has free movement across the table for the different kinds of work to be done. The face of this fence is planed perfectly true and accurate.

A boring machine and routing table, having a very large range of work, is attached when wanted—the table being raised and lowered independently by means of a crank, shown in cut. A fence for angle boring is fitted on the table, with stops for spacing the holes and routing.

This machine will make, in a very superior manner, glue joints; plane "out of wind;" chamfer; cross gain; groove; cut straight, circular, or elliptical mouldings; tongue and groove; corner; plane taper; raise panels; mitre; rabbet; will rebate and joint window blinds at one operation; make serpentine and wave moulding; table joints; fluting and beading on corners or face of balusters; plowing; rip and cross cut sawing; boring; routing, etc., etc.

A countershaft with improved floor hangers is furnished when needed. The loose and tight pulleys are 10 inches in diameter by 5½ inch face, and should make 650 revolutions per minute.

This machine is made by the Cordesman & Egan Company, 201 to 221, West Front St., Cincinnati, Ohio.

The Korting Exhaust Steam Induction Condenser.

In our issue of June 30, 1883, we illustrated and described this condenser and its application to steam engines under different circumstances. Since then, experience in its use has suggested improvements in its construction, and we present with this an engraving showing not only the features of improvements, but also sectional views that show the construction much more clearly than the former illustration.

As now made, one of its important features is the unobstructed passage for the water through the water nozzle. As will be seen from the engraving, this passage is quite clear, so that foreign matter in the water will not operate to obstruct it. This water nozzle has also been extended upwards, which facilitates the formation of a solid water column, and increases the steadiness of the action of the condenser. These nozzles are made interchangeable, so that in case the work on the engine is light a small nozzle may be used, thus economizing in the use of water; then if, in time, more work is added, a larger nozzle may be substituted without making other changes.

The two detached views near the top of engraving represent—the upper one a plan and the lower one a sectional elevation of the free exhaust and check valves. The first of these provides for exhausting into the atmosphere, either through its automatic action should the supply of condensing water fail at any time, or through being permanently set for that purpose; the lever *M* of this valve being moved into either of three positions. Thus, when the lever is inclined downward, the valve is closed; when the lever stands directly out, or in a horizontal position, the valve will open automatically and will also close automatically as soon as the condenser is started; by placing the lever in a position inclined upward, the valve is held permanently open. The free exhaust is through the pipe *J*. The check valve is to prevent the possibility of the condensing water returning to the cylinder.

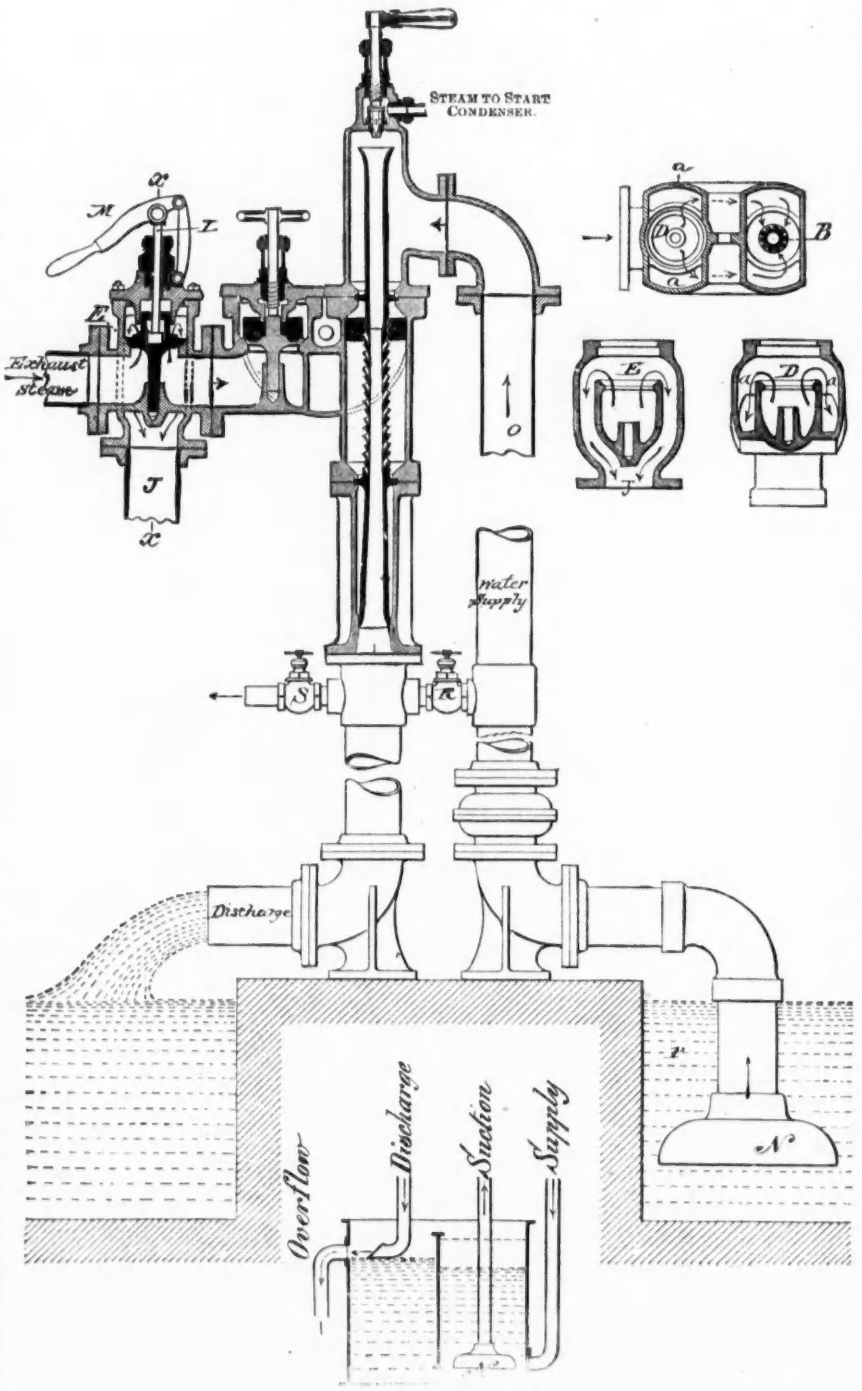
To obtain the full benefit of the water leg (that is, the pipe through which the water is discharged), it is necessary that the same should run full, which is the case when the discharge is under water, or when its diameter is of the exact size. To obtain this same result when the discharge is above water, or the pipe of larger diameter, a trap is attached to the lower part of the discharge pipe.

The small cut at bottom shows, in part, an arrangement sometimes advisable where the water supply is limited. In this case, a tank is made with a partition, as shown, the discharge from condenser being at the top at one side of this partition. There is also an overflow on this side at the top. The condenser takes water from the other side of this partition, and on this side there is also a pipe that supplies cold water. By this arrangement a portion of the condensing water may be used over, a cock in the supply pipe being used to regulate the supply so as to keep the water at a temperature sufficiently low to serve its purpose. It will be understood that the coldest water will be at the bottom, where it enters the supply pipe, and that the hottest will be at the top, and together with the grease and dirt will pass out of the overflow. By feeding the boiler from this side, sufficiently below the surface to avoid the grease and dirt, warm water may be had for that purpose.

These condensers are manufactured by L. Schutte & Co., Philadelphia. They are sold in New York by A. Aller, 109 Liberty Street, and in Boston by Jarvis Engineering Company, 61 Oliver Street.

The Singer Manufacturing Company, New York, exhibited the largest display of sewing machines that were shown in the recent Exhibition at Calcutta, India. A correspondent of the *Ironmonger*, writing from the exhibition, says of this exhibit:

"This collection is by far the largest of its kind, and, I may add, it equals, if not exceeds, the aggregate of sewing-machines shown by all other manufacturers in the exhibition. Visitors to this court are permitted every facility for testing the merits of their machines. The ease and rapidity with which work of the most delicate and intricate kind is performed on the finest muslin up to the coarsest material is a distinct proof that the greatest care as regards finish and material used, combined with inventive skill, are embodied in all the productions of this company. The company have a large branch establishment in this city, where a much larger collection of machines are to be seen than at the exhibition. The orders registered since the opening day have been very encouraging, and it is pleasing to note that among the many grumblers this company have, at any rate, reason to be satisfied with the business done through the exhibition."



Korting Exhaust Steam Induction Condenser.

Running a Lathe.

By Frank H. Richards.

EIGHTH PAPER.

I don't know that it is true that an oculist must spoil a hatful of eyes before he becomes expert at his profession, and if I believed it I would hesitate long about telling any one of my belief. A fellow learning the trade should not be too ready to console and excuse himself over his failures. It is inevitable that he will make some blunders, but he ought to kick himself all the same when they occur. There has to be a lot of fault-finding done by somebody, and it is only a question by whom it shall be done. Wherever good work is done, and progress is being made, it is because some one is constantly finding fault with things as they are. It is, of course, pleasanter, and every way more profitable, that a fellow find fault with himself and his work than that some one else have to do it for him, but the duty should not be neglected. Fault-finding may be taken as a mark of favor. If I find fault with anything, or with any one, it is to suggest and hope for improvement. I never waste my breath in finding fault with a fellow whose case I consider hopeless.

There is a peculiar class of individuals who, I might almost say, expect to spoil their first job every time. If things come out wrong—which is likely to happen—they have at hand the reasonable excuse that they never did that job before, and that is why they failed, and they will do better next time. The worst of it is that too often there is no next time. The second job is given to him who succeeds with the first, rather than to him who fails. And then there is a constant succession of novelty in machinery, so that a man may work in the shop forty years and be as expert as possible in his calling, and still he will constantly have to do something that he never did before. There is no getting out of it; however we may dislike the effort required, we must think, and plan, and study, and acquire the habit of keeping ahead of our work, so that instead of being not quite able to do the job of to-day we can do it thoroughly and be ready for the job that may come along the week after next, and perhaps feel somewhat slighted and discouraged because it does not come sooner.

Learning the art of calipering the diameters of work, and of making fits, begins with almost our first work upon the lathe. There is an impression prevalent—and the facts seem to warrant it—that the art of making fits is slow and difficult of acquisition. It is rare among machinists to find one who is absolutely reliable. They have their streaks of "luck," good and ill, like a woman baking cake; yet I am inclined to think that proficiency in the art is attainable by any one of average ability.

The first thing of all is to keep cool about it. We should know and not overestimate the amount of difficulty involved, and in what part of the operation it lies. Too many possible machinists are spoiled at the outset of their career by being frightened out of their wits. No one was ever made cooler in that way.

Don't begin with quarters and eighths of an inch and hope to get to hundredths in about a quarter of a century. Instead of shying lead yourself right up face to face with thousandths, and you will see that there is nothing terrible about them. Borrow a Brown & Sharpe micrometer caliper and adjust it so that it will just pass over, touching both sides, a piece of straight $\frac{1}{8}''$ wire, or something like that. Open the caliper $\frac{1}{1000}''$ and try it upon the wire again, and you will find—holding it square, of course—that you can't possibly make the caliper touch both sides of the wire at the same time. This little operation will prove to you, because you will have done it, that you are perfectly able at the very beginning of your mechanical career to measure to thousandths of an inch.

If you can't borrow a micrometer caliper you can do better without it, and be independent besides, which is worth ten cents every time, and you may deposit that amount to my credit. Take a mandrel or an arbor—I don't know which is which—or, say a piece of 1″ round iron about 1′ long, and turn it with a slight taper so that, commencing from the end, it will slowly increase in size until at 10″ from the end it will measure $\frac{1}{100}''$ larger than at the end. Now take a V tool and mark it around at each inch of its length. File it smooth. Now, if the difference in the diameter of it be .01″ in 10″, it will be .001″ in 1″, and for any fraction of an inch it will be proportionately smaller. $\frac{1}{2}''$ in length will give you .0005″; $\frac{1}{4}''$ will give .00025″, and so on. You will thus be provided with the means of finding out how fine and accurate are your sense of touch and steadiness of hand. You will know precisely how minutely you can measure. You will, as the scientific fellows say, have determined your personal equation. It has been determined by actual experiment that a good machinist can detect a difference of .00005″. This would be represented upon your taper mandrel by a length of $\frac{1}{20}''$. Try it, and see how much length you need to detect the difference. In a common book there are about 400 pages, or 200 leaves to an inch in thickness; therefore, a single leaf of the paper measures .005″, and your arithmetic will tell you that you can't call yourself a real high-toned machinist until you can measure with calipers alone, not to one hundredth of an inch, but to the one-hundredth of the thickness of a sheet of paper.

Now to make a fit. Remembering always that the only way to learn anything involving manual skill is by actually doing it, we will try to consider the operations involved. We will take a simple case, such as might

occur any day in almost any machine shop. We take a pair of inside calipers and measure a bored hole, say 3″ diameter. This operation, simple enough to speak of, requires the greatest care, and for its successful achievement a delicacy of touch that can only be acquired by frequently and patiently doing it. After repeated trials and adjustments, holding one point of the calipers against one side of the hole and feeling with the other point for the largest place that will let it pass to and fro, touching as lightly as it can and at the same time give to the sense of feeling the assurance that it does actually touch. We now have taken the measure of the hole, and while taking it have mentally noted its peculiarities. By trying the calipers in various places we know whether the hole is taper or straight, and if taper which end is the largest, and whether it is perfectly round, and also how rough or smooth the surface, is all of which particulars must be borne in mind. We now take a pair of outside calipers and bring their points opposite those of the already adjusted inside calipers, moving them back and forth to bring their most prominent points opposite and in contact with each other, and adjust them so that the sense of touch just gives assurance of actual contact, and no more. The ideal calipers should, of course, always keep their measuring faces flat and parallel, and then this tedious searching for the highest points of two curved surfaces, and the uncertainty of finding them exactly, would be avoided. With jointed calipers, and the round points which they necessitate, there must be a different point most prominent at each change of size. Calipers consisting of arms sliding upon a straight bar would, of course, present parallel faces, but they are large and inconvenient in other respects, and are not likely to be adopted. We now proceed to turn a piece as accurately as possible to the size of these outside calipers, in the measuring letting them touch as lightly as we can. When this piece is turned we have gone through all the operations involved in making a fit, and they don't seem numerous or complicated. We take our turned piece which we have fitted so carefully, touching off the sharp corners with a file, wiping all the dust from it and from the hole with care, oiling the surfaces of both, for safety, and try to insert it into the hole to which we have fitted it. For the final wiping of surfaces like this the bare hand is better than any waste or anything else that I have ever used. As to always oiling things for safety, I suppose every machinist has to sometime put a piece into a hole dry and have it seize and "chaw" things before he is impressed with the necessity. With some a single lesson suffices, with some forty are required, and with some forty thousand are insufficient. My number was about seventeen, the last one not long ago. Well, about our fit. It won't go. It is too tight, and would require considerable power to drive it in. In this, our failure, there is no assurance that our senses are less to be relied upon than those of others. Here is simply the wise man's opportunity to learn the why and the how—why we have failed, and how we may succeed.

It is to be observed in the first place that our inside calipers, as we have adjusted them, do not represent the actual size of the hole we have measured, but a size somewhat larger. The most rigid calipers will still spring more or less. The contact with the sides of the hole sufficient to be evident to our sense of touch causes them to spring inward somewhat, though ever so slightly, and therefore they represent a size a trifle larger than that of the hole to which they are adjusted. This brings us to remark with regard to calipers we use; first, the importance of having them as rigid as possible, with a good, large, firm joint, and stiff and unyielding in the legs; second, the equal importance of using calipers with which by long use we are familiar, so that our judgment is trained to know, though unconsciously, perhaps, what allowance is to be made for their springing. This latter point of remark applies to many other tools used by the machinist, and shows the disadvantage at which the workman is placed who is not reasonably supplied with tools of his own. There is little to be said as to the particular form of calipers to be preferred. It is well, however, to use those provided with an adjusting screw, as without that the patience of the workman is apt to be exhausted before they are adjusted with the desired nicety. Think of knocking them .00005″ smaller or larger! Stevens & Co. are making some good calipers.

In the second place, besides the springing of the calipers the imperfections of the hole all tend to make our fit too tight. The hole probably is not perfectly round, most certainly there are ridges and hollows left by the tool running around it, there may be chatters more or less perceptible, or even not seen at all, extending lengthwise through it. The point of our calipers which we hold against one side of the hole settles probably into one of these depressions, while it is not these depressions but the most prominent points which are the points of contact with whatever is fitted to the hole. If we drive a piece of turned iron—not filed—into a bored hole pretty tight, and then drive it out, we shall notice that only the most prominent parts of the surface have been in contact. If we have had some experience in that line when we see a piece which has been forced into a hole and afterwards removed, as, for instance, a car axle and wheel, and which has the appearance of having been in contact along its whole surface, or nearly so, so that the tool marks are obliterated, we know immediately that it has required an enormous power to force it in. The workman, then, has to consider the condition and finish of the surfaces which he is fitting, and train his judgment to make allowance accordingly.

These two points which we mention: the springing of the calipers and the inequalities of the surfaces, each have their effect in the use of the calipers and each tends to make their measure somewhat incorrect. These points do not operate against each other, they do not compensate and balance each other; they tend to the same result, that of making too tight a fit. The hole is smaller than the inside calipers indicate, the shaft is larger than the outside calipers indicate. As an offset to this, and tending to the opposite effect, there is the springing of the calipers that occurs when the outsides and the insides are compared and the size is transferred from the one to the other. The tendency of whatever the calipers spring in this case is evidently to make the fit looser; but supposing the contact in this case to be no harder than when we measured the work it still leaves some inaccuracy uncorrected. To correct and make allowance for these inaccuracies that arise in the measurements is the task of the workman, and constitute the whole difficulty of the case. When we compare the calipers together they should be made to touch each other somewhat harder than we make them touch the work, and in this point of comparing and transferring the size is the most delicate and trying operation in making a fit. By the way in which the calipers match each other the fit may be made whatever is desired. No practical method can be brought to express this in figures. It is a matter of feeling rather than of sight.

Having come thus far I have to acknowledge my utter inability to teach any one by any amount of writing or talking how to make a fit. It can only be learned by doing it; yet I cannot but think that in thus calling attention to some of the details of the operation I may be of service to some one. By using all the care we can exercise, and by remembering, and profiting by each successive experiment we can soon be able to make a fit with certainty and confidence.

The Indicator Diagram.

By F. F. Hemenway.

EFFECT OF DERANGED VALVE MOTION.

The diagrams from which Figs. 22 and 23 were engraved were sent me by the manager of a large manufacturing establishment, who writes as follows: "I enclose two cards taken from an engine 22″×30″, running at 75 revolutions, and under the back pressure shown, the steam being further used after it leaves the cylinder. The eccentric disk was moved from its proper position, and while the engine run and did its work it thumped so in the main journal boxes that we knew something was wrong. The indicator was applied, the result being these cards. I cannot understand why the pressure went below the atmosphere, with so much back pressure on the exhaust. I also enclose two cards taken when the eccentric was in its proper place."

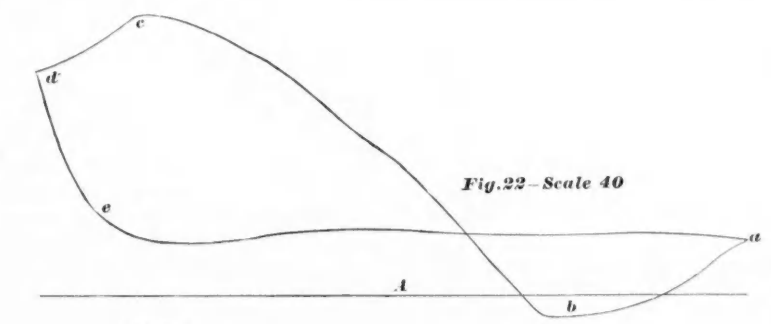


Fig. 22—Scale 40

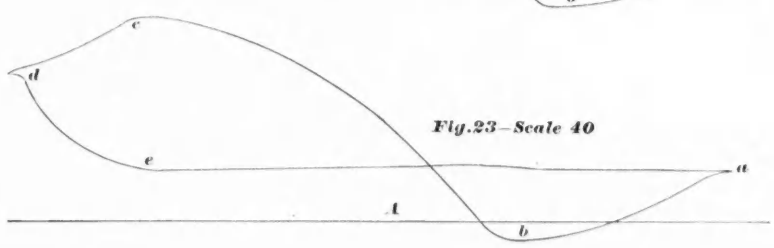


Fig. 23—Scale 40

The two diagrams last referred to were taken, one from each end of the cylinder, but were both taken from one direction, viz: from left to right. They are not reproduced, because they present no especial peculiarities, except in the back pressure against which the engine was exhausting. The cut-off is short, expansion down to the line of counter-pressure, with early exhaust opening and closure, the compression being quite up to steam chest pressure. The last three features are those found in diagrams from automatic cut-off engine in which the entire steam distribution is accomplished by means of a single valve. The diagrams shown in Figs. 22 and 23 are also from different ends of the cylinder, 22 being from the top, and 23 from the bottom. They were not taken upon the same day in which the others were. At first sight they have the appearance of having been taken, like the others, from left towards the right, the line *e d* being the compression curve, and *d c* a late admission line, further modified by the use of a valve with a serrated admission edge. Reasoning in this way, the cut-off would be near *c*, but then comes the difficulty of accounting for the steam expanding so low. Fortunately, however, the line *c b* is in itself an impossible expansion curve in other respects than that of falling too low and irregularly; it is convex instead of concave—something that it would be substantially impossible to invent a theory for. The conclusion then, is that these diagrams were both traced from the right towards the left. Beginning at *a* the piston moves ahead, but the valve being behind time the port is covered. Considering diagram 22, there is at the beginning of the stroke a pressure of 26 lbs. (absolute) in the clearance space, whatever that may be. The piston moving along and the port remaining covered the pressure falls precisely as if cut-off had occurred at the very commencement of the stroke and with that pressure (26 lbs.) in the clearance space, the amount of back pressure against the other side of the piston of course having no direct influence on the pressure on this side. The valve did not open for admission until the piston had reached a point in its stroke represented at *b*. Then the motion of the piston was so rapid that the pressure behind it was increased slowly, as represented by the line *b c*, in this respect the diagram representing an aggravated case of late admission without any assistance from compression. Under these conditions the convexity of the line *b c* is accounted for, as it represents exactly what would be sure to follow.

At *c* steam is cut off, and *c d* is the expansion line. This line is concave, as it should, and as it surely would not be—that is not for its entire length—if it were the admission line. The exhaust begins to open at *d*, and the pressure falls slowly—because the exhaust is late—till at *e* it is equal to that against which the piston is working.

In diagram 23 substantially the same conditions are represented, the only difference being that brought about by the valve not being quite "square."

The diagrams referred to but not shown, represent the steam expanded to the lowest economical point—in fact a little too low, the expansion being, as previously mentioned, to the line of counter-pressure. In the one shown the mean effective pressure is about the same as in the others, but the pressure at release is an average of more than 60 per cent. higher. Besides this in one instance the clearance space is filled with steam by compression of steam chest pressure, while in the other nothing is saved in this way. The difference in fuel consumption in the two instances was, so far as furnishing power is concerned, enormous by comparison, and but for the fact that the steam exhausted was utilized would have demonstrated without delay that something was wrong.

Automatic Freight-Car Brakes.

A committee appointed by the Master Car Builders' Association has issued a circular requesting an expression of opinion from members on the subject of "automatic freight-car brakes." The circular contains five questions which are framed to obtain authoritative opinion as to whether or not automatic freight car brakes are necessary if they are practicable, and what amount per car roads are disposed to expend on brakes of that character. Whatever action the Master Car Builders' Association may take in the premises it is hard to say, but certain enterprising Western railroad companies are working towards a solution of the freight-car brake problem. The Denver & Rio Grande Railroad Company have had air brakes on the whole of their freight cars for six or seven years, the Atchison, Topeka & Santa Fe Railroad cars are being similarly equipped, and several other roads are getting continuous brakes on their freight cars as fast as possible. This improvement enables the speed of freight trains to be safely accelerated 25 per cent. and prevents numerous wrecks, by putting the control of the train into the hands of the engineer.

Occasional notes in our British contemporaries indicate that the Giant's Causeway & Portrush Electric Railway, which is operated by power derived from a waterfall, is prospering. The latest incident pointing to its vitality is the killing of a horse which had been grazing alongside the track and ignorantly touched the electric-conducting rail with its nose.

Laying Out Link Motion.

By J. G. A. Meyer.

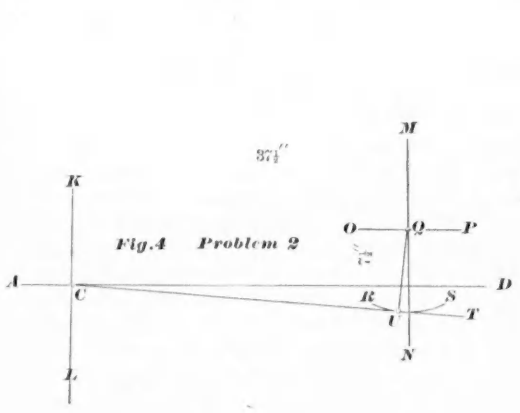
SECOND PAPER.

PROBLEM 2—FIG. 4.

To find the center line of motion and the amount of off-set in the lower rocker arm.

Let C be the center of axle; through C draw the straight lines, $A\ D$, and $K\ L$, perpendicular to $A\ D$. The center of rocker we find in Fig. 1, (May 10) to be $37\frac{1}{2}$ inches in front of the center of axle, and $7\frac{1}{2}$ inches above. We therefore continue our construction in Fig. 4 by drawing a straight line, $M\ N$, $37\frac{1}{2}$ in. front of, and parallel to the straight line $K\ L$, and another straight line, $O\ P$, parallel to $A\ D$, and $7\frac{1}{2}$ inches above it. These two lines intersect in the point Q, and this point is the center of rocker. With Q as a center and a radius equal to the length of the lower rocker arm, describe the arc $R\ S$; through the point C, draw a straight line $C\ T$ tangent to the arc $R\ S$, then C, T will be the center line of motion.

To find the amount of off-set in the lower rocker arm, let us place the center line of the upper rocker arm perpendicular to a line drawn parallel to the valve surface, but in our case this valve surface is parallel to the line $A\ D$, hence our line drawn parallel to the valve surface will also be parallel to the line $A\ D$, and the center line of upper rocker arm will be perpendicular to $A\ D$, and coincide with the line $M\ N$. Through the point Q draw a straight line perpendicular to the line $C\ T$, and intersecting the arc $R\ S$ in the point U; then the distance from the point U, to the line $M\ N$ will be the amount of the off-set in the lower rocker arm.



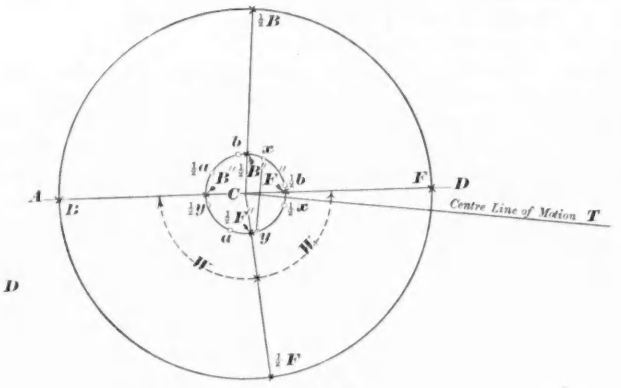


Fig.5 Problem 3

PROBLEM 3—FIG. 5.

To find the relative positions of crank-pin and eccentrics when the piston is at full and half stroke.

Let C be the center of axle. Through C draw the horizontal line $A\ D$, and find the positions of center of crank-pin at full and half stroke, namely the points F, $\frac{1}{2}\ F$, B, $\frac{1}{2}\ B$, as explained in problem 1, and shown in Fig. 3. Next draw the center line of motion as explained in problem 2, and Fig. 4. With the point C as a center and a radius equal to $\frac{1}{2}$ the throw of the eccentric ($2\frac{1}{2}$ inches) draw a circle, and let us call this circle the "eccentric circle." On the line of motion, $C\ T$, lay off a point towards the rocker $\frac{13}{16}$ of an inch from C, (this being the sum of the lap and lead, $\frac{3}{4}$ of an inch for the lap and $\frac{1}{16}$ of an inch for the lead) through this point draw a straight line perpendicular to the line of motion $C\ T$, and intersecting the eccentric circle in the points x and y. The point x will be the center of the forward eccentric and the point y will be the center of backward eccentric when the center of crank-pin is at F, full stroke forward. Through the points F and C, draw a straight line intersecting the eccentric circle in the point F'''. The line $F\ C$ will represent the center line of crank, and the distance between the points F''' and x, measured on the eccentric circle is the amount that the center of forward eccentric is set back of the center line of crank, and the distance between the points F''' and y is the amount that the backward eccentric is set ahead of the center line of crank. Since both the crank and eccentrics are fastened to the same axle, it follows, that, whatever position the center line of crank may be in, the distances between center line of crank and eccentrics, that is the distances between F''' and x, also F''' and y, measured on the eccentric circle, remain constant. Therefore to find the position of eccentrics when the crank stands at $\frac{1}{2}\ F$ (half stroke) draw the straight line $\frac{1}{2}\ F\ C$ representing the center line of crank, and intersecting the eccentric circle in the point $\frac{1}{2}\ F'''$. From the point $\frac{1}{2}\ F'''$ lay off on the eccentric circle a point with a distance equal to $F'''\ x$, back of the center line of crank, and indicate this point by $\frac{1}{2}\ x$, also from $\frac{1}{2}\ F'''$ measured on the same circle, lay off a point in the front of the center line of crank, and with a distance equal to $F'''\ y$, and mark this point $\frac{1}{2}\ y$, then the point $\frac{1}{2}\ x$ will be the position of forward eccentric, and the point $\frac{1}{2}\ y$ will be the position of backward eccentric when the crank-pin is at $\frac{1}{2}\ F$. In precisely the same manner we find the position of eccentrics when the center of crank-pin is at B (full stroke back). Through the points C and B draw a straight line, intersecting the eccentric circle in the point B''. From the point B'', and with a distance equal to $F'''\ x$, lay off a point on the eccentric circle back of crank; this point will be the position of forward eccentric when crank is a full stroke back, and in order to distinguish this from the other position of eccentric call this point a; also from B'' lay off in front of the crank, the position of backward eccentric at a distance equal to $F'''\ y$, and call this point b. In the same manner find points $\frac{1}{2}\ a$ and $\frac{1}{2}\ b$ when the crank-pin is at $\frac{1}{2}\ B$. We have now found the position of eccentrics when the crank-pin stands in the following positions:

Full stroke forward F, the forward eccentric will be at x.

Half stroke forward $\frac{1}{2}\ F$, the forward eccentric will be at $\frac{1}{2}\ x$.

Full stroke back end B, the forward eccentric will be at a.

Half stroke back end $\frac{1}{2}\ B$, the forward eccentric will be at $\frac{1}{2}\ a$.

Full stroke forward F, the backward eccentric will be at y.

Half stroke forward $\frac{1}{2}\ F$, the backward eccentric will be at $\frac{1}{2}\ y$.

Full stroke back end B, the backward eccentric will be at b.

Half stroke back end $\frac{1}{2}\ B$, the backward eccentric will be at $\frac{1}{2}\ b$.

PROBLEM 4—FIG. 6.

To determine the correct length of the eccentric rods: Let c be the center of axle. Through this point draw the horizontal line $A\ D$, also a line, $K\ L$, perpendicular to $A\ D$. The only purpose for which these two lines are drawn in this problem, as well as the others, is to have some lines from which we can locate other lines or points. Locate the center of rocker and center lines of rocker arms, as explained in problem 2 and shown in Fig. 4, the lower arm standing perpendicular to the center line of motion, and the upper arm vertical. When the arms stand in this position, the rocker pins will move through an equal distance on each side of these center lines during the time that the valve is making its full travel.

Next find centers of eccentrics x and y, when the crank is at full stroke forward; also a and b, when the crank is at full stroke back, as explained in problem 3 and shown in Fig. 5. Before we proceed, let us give names to some of the lines, as shown in Fig. 6*a*. The arc $c_1\ c_2$ drawn through the center of opening of the link we will call the link arc, and the arc $d_1\ d_2$ drawn through the center of eccentric rod pin holes we will call the eccentric rod pin arc. Both of these arcs are drawn from the same center; that is, the center from which the link is drawn. Let us now cut a paper template, as shown in Fig. 6*b*. This template is cut so that, if it is laid on the link, Fig. 6*a*, the arc of the template $c_3\ c_4$ will coincide with the link arc $c_1\ c_2$, and $d_3\ d_4$ with the eccentric pin arc $d_1\ d_2$, the end of template $d_3\ c_3$ with the line $d_1\ c_1$, and the end $d_4\ c_4$ with $d_2\ c_2$. On this template join the points $c_3\ c_4$ by a straight line, and bisect this line by the perpendicular line $e\ e$; on this line the center of the saddle pin will be located. On one side of this line draw the line $f\ f_1$ parallel to $e\ e$, and on the other side draw $f_2\ f_3$, also parallel to $e\ e$; the distance from the point f to the point f_2 being equal to the distance between the centers of eccentric rod pins, and $f\ e$ equal to $e\ f_2$. The points f and f_2 on the arc $d_3\ d_4$ indicate the position on the template of the centers of eccentric rod pins. On the center line of motion $c\ T$, lay off from v a point v^1 towards the axle, with a distance equal to $c_1\ d_1$, Fig. 6*a*; then, with the point x as a center and $c\ v^1$ as a radius, describe the arc $x_1\ x_2$; in this arc the upper eccentric rod will be located as long as the center of forward eccentric remains at x. With the point y as a center and $c\ v_1$ as a radius, describe the arc $y_1\ y_2$; in this arc the center of lower eccentric rod will be located as long as the backward eccentric remains at y. With the point a as a center and $c\ v_1$ as a radius, describe an arc $a_1\ a_2$; in this arc the upper eccentric rod pin will be located while the forward eccentric is at a. With the point b as a center and $c\ v_1$ as a radius, describe the arc $b_1 b_2$; and in this arc the center of lower eccentric rod pin will be located when the backward eccentric is at b. Now adjust the template on the drawing so that the point f will be in the arc $x_1\ x_2$; point f_2 in the arc $y_1\ y_2$ and the line $e\ e$ coincide with the center line of motion $c\ T$. Along the arc $c_3\ c_4$ of the template draw an arc on the paper. Next move the template so that the point f will be in the arc $a_1\ a_2$, the point f_2 in the are $b_1\ b_2$, and the line $e\ e$ coincide with the center line of motion $c\ T$, and along the arc $c_3\ c_4$ of the template draw the second arc on the paper. Now if the distance measured on the arc $R\ S$ from the point v (the center of the lower rocker arm pin) to the first arc drawn, is equal to the distance measured on the arc $R\ S$ from v to the second arc, the radius $c\ v_1$ will be the correct length of the eccentric rods. But if the distance from v to the first arc is less than the distance from v to the second arc, the length $c\ v_1$ of the eccentric rod will be too short. In this case we must increase the length $c\ v_1$ by adding an amount equal to one-half the difference of the distances from v to the first arc, and from v to the second arc previously drawn, and this last length so found will be the correct length of eccentric rods.

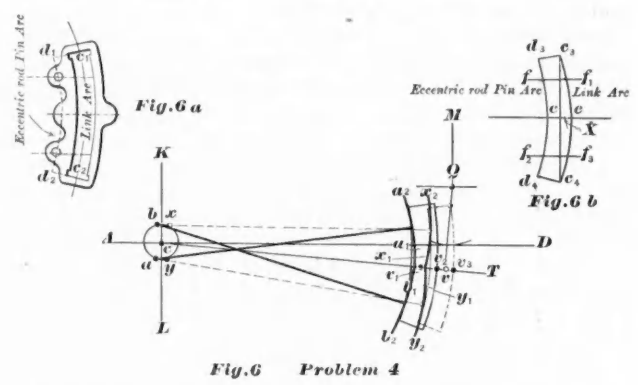


Fig.6 Problem 4

It will be proper to remark here that the radius $c\ v_1$ was assumed to be the correct length of eccentric rods; but since the rods cross each other when the eccentrics are at a and b, and do not cross each other when at x and y, the radius $c\ v_1$ will always be a trifle short; it is therefore necessary to make the correction as explained.

In every case the length of eccentric rods must be so adjusted that, when the line e, e coincides with the center line of motion $c\ T$, the arc $v\ v_2$ (which is the amount that the rocker pin is drawn towards the axle from the line $Q\ v$ when the eccentrics are at a and b) must be equal to the arc $v\ v_3$ (which is the amount that the rocker pin is moved towards the cylinders from the line $Q\ v$ when the eccentrics are at x and y) the straight line $Q\ v$ being perpendicular to the center line of motion $c\ T$.

Billings' New Cutting-Off Tool.

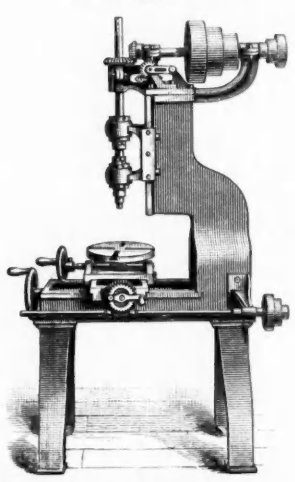
The engraving represents a new cutting-off tool, made by the Billings & Spencer Company, Hartford, Conn. The tool proper consists of a piece of steel of the desired thickness, the edges being beveled as shown in the sectional view. The holder for the tool is in two parts, channeled out on one side to receive the tool, and held together by two screws, as shown. These screws do not project at either top or bottom, so that when the two parts of the holder are together with the tool in position, the whole fits in the tool post like an ordinary lathe tool, without projections to hinder its being moved to any desired position. The two screws that hold the two parts of the holder together pinch the tool or cutter so as to hold it for grinding, etc., while the set screw of the tool post holds it firmly for cutting. The lower part of the holder projects beyond the upper part for the purpose of affording a better support to the cutting edge of the tool, but when desired the tool may be reversed end for end in the holder, which will better adapt it for use on a planer.

It will be seen that the tools or cutters may

vary in width or in thickness without in any way interfering with their use in the holder, in other words exact fitting in this respect is not required. This appears to be a very convenient tool for machinists' use, as it can be used precisely like an ordinary lathe tool.

White's Flexible Metallic Fillet for Patterns.

The little engraving clearly represents sections of this fillet, which is designed for use on patterns. It is made of fusible metal, can be readily bent to any desired shape, and its use saves both time and labor. It is hardly necessary to say that it makes a neat and permanent fillet, unaffected by moisture. It is highly recommended by those who have used it. It is neatly put up in reels of 100 feet, by H. B. Smith Machine Company, 925 Market Street, Philadelphia, Pa.



Dancel Vertical Milling Machine.

The vertical milling machine here illustrated in perspective has been designed to meet the requirements of the trade for a small machine capable of being applied on a great variety of work. The arrangement of the parts are such that a job requiring considerable table movement can be operated upon. The milling cutter has a vertical movement of 11 inches, the table has a transverse movement of 14 inches, and the feed range is 17 inches, which can be guided straight, elliptical or circular.

The cutter spindle, which is of steel, receives its motion through bevel gears from a horizontal driving shaft, which carries the pulley cone. The spindle revolves in three long boxes, the two lower ones being bushed with hard brass. The cross-feed has a power attachment. On the base of the table there is a circular flange, on which a clasp is fitted at the front and back, which can be screwed down to prevent back lash when heavy work is being cut.

This machine is found very convenient for doing the work on small frames, where there are slots or dovetails at different angles, for they can be finished without taking the work off the table. It has been used successfully in cutting bevel gears, a special attachment being put on the table to regulate the cut. The machine is solidly made and put together in good shape. C. Dancel, 239 Centre Street, New York City, is the maker.

One of the curiosities among smoke-consuming devices is a recent patent, where the inventor proposes to inject air into the boiler along with the feed water. He then proposes to draw a mixture of steam and air from the boiler, and throw it in jets upon the surface of the burning fuel. Another inventor in the same field proposes to decompose steam by passing it down through incandescent or highly-heated fuel. The resultant gases are then to be passed through a second body of fire for converting any contained carbon dioxide into carbonic oxide. The gases now prepared are to be drawn off by an injector, which will mix them with volatile hydrocarbons that will be discharged over the fire-bed. There seems to be great activity among inventors to produce improved methods of combustion.

LETTERS FROM PRACTICAL MEN.

Compound Locomotives in Europe.

Editor American Machinist:

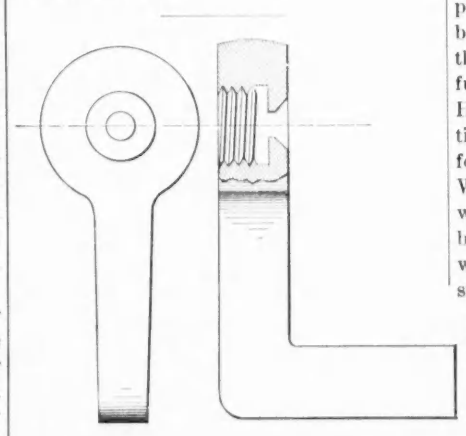
Having noticed a paragraph in your valuable paper of April 12, on "Compound Locomotives in Europe," permit me to write a few words about them.

During a visit in England last summer I had the opportunity of becoming acquainted with Mr. Webb's compound engines. I had the pleasure of riding on them between Crewe and Stafford, and I may say it was a pleasure to ride on them, as I have rode on many engines both in this country and in England, and I may say they run like a bicycle. I entered into conversation with the drivers about the amount of fuel they burned, and one of them stated that he had been driving for more than 27 years, and he showed me a record of the amount of fuel that he had used in running this engine for over 3 months, and it showed no more than 27 lbs. of fuel per mile, and he also stated that the record which he kept of the Standard engines he had been running before was never less than 34 lbs. per mile. So I consider that this is a great saving in fuel, and I believe that Mr. Webb has not got the compounds to perfection yet, and that he will obtain far better results from them. I believe the first engine he built for experiment had been running for 12 months, and it was taken in the shops to have the vacuum brake put on. I went into the running sheds to inquire about the amount of repairs that had been done to this engine during the 12 months, and I found there was literally no repairs done. I found that one great thing he had applied to all the new engines was a small pipe running from the cab to the low pressure cylinder so as to admit steam into the cylinder in starting, so in case it should be on its center it would start much easier. The engines look very neat, and they start from a station very quick and steady without a slip from them with 12 cars behind them.

I hope you will pardon me if I am intruding on your valuable paper. I have had 10 years' experience as a practical mechanic, and I can assure you that I was much interested in the compound.

A PRACTICAL MECHANIC.

Stratford, Ont.



A Thread Dog.

Editor American Machinist:

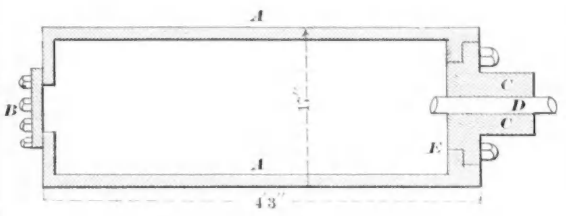
About three years ago I made a half dozen thread dogs of the enclosed design, and they have been received with so much favor by the lathe hands that I have since made a complete set, and duplicates. They are intended for use in finishing the threading of studs, or for finishing the heads of locomotive guide bolts, or anything that has a threaded end which it is necessary to catch with a carrier or dog while performing some other operation on it. As will be seen, they are solid, and it is necessary to have one for each standard size of bolts or studs that you turn. The manner of construction is clearly shown in the sketch. The hole and countersink on reverse side is made of sufficient size to admit of the free and ready entrance of the lathe center into the center in end of work. This dog will be a missionary in any shop where it is freely used, removing the necessity of any future record of profanity for the individual user. W. H. D.

Patent on a Tool Post.

Editor American Machinist:

Seeing a cut of a proposed tool holder or post in your paper by Mr. P. C. Forrester (Vol. VI., No. 41, page 6,) which he says would be very effective, I must say that several machinists will agree with him. It is a handy arrangement for boring long holes and taking heavy cuts, as the tool can be held perfectly rigid, and it is easily adjusted. The invention, however, is mine, as the records in Washington will show. A patent was pending when the suggestion of Mr. Forrester was made. A. MERCER.

15 Union Street, Norfolk, Va.



A Curious Explosion.

Editor American Machinist:

There occurred a very singular explosion at the water works at Janesville, Ohio, on the evening of April 18th, 1884. They have a pair of Worthington, high pressure inside duplex plunger pumps, plunger 17 inches diameter and 4 feet 3 inches long. The piston rod broke and had to be taken out for repairs. The plunger was removed from the pump, and laid on the floor for the purpose of getting the broken rod out. The construction of the plunger may be seen from the sketch. *A*, *A*, is the plunger, *B*, a blind cap, on the back end of plunger, and *C* is the head on the opposite end, to which the piston rod *D* is fastened, this head being bolted to the plunger *A*. The plunger *A* being hollow, the caps *C* and *B* are fitted close, so as not to allow any water on the inside of the plunger. The machinist had taken out the bolts on the head *C*, but the head refusing to come off he took off the cap *B*, so as to put in a bar to force it off. After taking off head *B*, he walked around the pump for a lamp, and came back and put the bar in, but not being able to see the end of the rod, he moved the lamp up to the end of the plunger, when there was a heavy explosion, blowing him about fifteen feet, and in between the stove and wall, with such force that he was picked up for dead, it being fully fifteen minutes before he came around. He was badly burned by the gas, which continued to burn on the inside of the plunger for 20 to 30 minutes after the explosion. When the cap *B* was taken off there was water and a thick mud, which resembled blue clay, up to the point *E* on the diagram; when dry this was about the color of rotten stone and had a very offensive smell. The plunger had not been open for about five years, and when pumping works against a head of 179 feet.

I should like you to lay this before the readers of the AMERICAN MACHINIST, and see if any one can give a satisfactory explanation as to the cause of the explosion. Remember that the plunger was removed from the pump, and was lying on the floor when the explosion took place.

J. H. GREENWOOD.

What Blew the Dome Off the Boiler?

Editor American Machinist:

On my way to the shop this morning I was startled by a sudden rushing noise, the cause of which I will explain: Among our other industries we have a spoke and bending factory, and I found that the cap of the boiler dome had blown off, tearing away the roof of the engine house and scattering things around generally, but fortunately injuring no one.

The boiler has been in position twelve or fifteen years. I examined the fractured part, and found that at the turn of the flange it was cracked and corroded till on one side (the dome was about 24″ in diameter) for about 18″ there was nothing but a scale of rust, and on the other side about 1/8″ of iron. The engineer tells me he had noticed a leak on the thin side for some time, and had tried to caulk it, thinking it *sand holes*, but that the last time they cleaned the boiler they sent a boy in with a candle to examine, and he reported it cracked. He then went in himself, and trying it with his knife, found he could stick the point of it through in places. He reported to his employers, and they told him they "guessed it would answer for a while yet"—to "go ahead."

He did so, and I suppose they were very much surprised when it blew off. It had carried from ninety to 120 pounds of steam for fifteen years, and had never acted that way before. It certainly was old enough to know better.

There was not the sign of a stay-bolt anywhere near the dome, and never had been. The steam pipe was attached to the top of safety valve. The engineer had just tried the safety valve, and found it all right. He was just about to blow the morning whistle, the engine having been running for ten minutes, steam at ninety pounds, and plenty of water. Has any one a clear idea of why it "let go?"

Wabash, Ind. H. H. GLEASON.

Melting Iron in an English Foundry.

Editor American Machinist:

I noticed in two recent issues of the AMERICAN MACHINIST letters from practical men on cupola management, and it occurred to me that, as our practice in the North of England is superior to what is given there, it would be interesting to compare notes.

The cupola at present in use in this foundry (one out of five) is 3′ 6″ diameter inside the lining, and is a plain parallel tube.

The tuyeres are eight in number, about 6″ square, and about three feet above the tap hole. The blast is supplied by a No. 25 Baker blower, and is about 75 lbs. pressure per square inch. With this pressure we melt at the rate of five tons per hour. We commence by lighting up in the ordinary manner, and filling up with coke up to about 21″ above the tuyeres. This takes about 13 cwt. of coke. After this the cupola man puts on 26 cwt. of iron, and then 1¼ cwt. of coke, and so on, iron and coke alternately, till the quantity required is melted.

The average daily quantity of iron melted in this cupola is 20 tons. Of the 13 cwt. of coke which is used to fill up the cupola, we get 6 cwt. back after the cupola is drawn. The other 7 cwt. is burnt and wasted, being mixed with the slag, so that we burn 7 cwt. plus 19.2 cwt. = 26.2 cwt. of coke to melt 20 tons of iron. This is equal to 147 lbs. per ton of iron melted.

The coke used is a Durham coke, and contains from 85 to 90 per cent. of carbon.

If we compare this result with the theoretical quantity of coke necessary to melt a ton of iron, it will show how near we work to the exact quantity required. Cast-iron melts at 2200° Fahr; its specific heat is .123, and the latent heat of liquefaction 233 (Clement).

Carbon burning to carbonic acid develops 12,906 heat units (Dulong), and with a cupola we may fairly assume that all the coke is burnt to carbonic acid.

In raising one ton of iron from the ordinary temperature—say, 50° Fahr.—to melting point, we require $2240 \times (2200 - 50) \times .123 = 592368$ heat units, and to liquefy it we want $2240 \times 233 = 521920$ heat units, so that one ton of iron will require

$$\frac{592368 + 521920}{12906 \times .85} = 101 \text{ lbs. of coke.}$$

The 46 lbs. which we use in excess is needed to melt the flux (limestone), and allow for waste heat ascending the chimney, radiation, etc., etc.

I have no experience of coal for melting iron. M. J. WHEATLEY.

North-eastern Foundry, South Shields, England.

Safety in Powder Mills.

Editor American Machinist:

In your issue of May 30, I notice an article under the heading "Safeguards in Industrial Establishments" which seems to have been written by some one who was unacquainted with the subject and the facts connected with it, so far as it relates to the employment of men in the manufacture of explosives.

An experience of more than thirty years in the construction and operation of establishments for the manufacture of gunpowder and other explosives has enabled me to gather statistics, and make observations, which show conclusively that the danger and risk of working such establishments is not nearly as great as mining, working on railroad trains, or several other employments in which large numbers of men and boys are employed, and that a large majority of accidents occurring in such works are the result of carelessness in the violation of well established precautionary rules by the operatives themselves.

Furthermore, I believe that no law could be enacted that would materially affect the condition or management of such establishments, nor if enacted could it be enforced for the following reasons:

The owners have a large money interest in such works on which no insurance is obtainable, and in case of an explosion there is a total loss which must fall on the owners exclusively; hence it is for their interest to use every precaution for safety that is possible, and then rely on careful supervision and the fear of instant death on the part of the workmen for the safe prosecution of the work.

But here comes in the curious part of the business which the public do not know, or forget, *the fear of instant death will not insure an observance of the ordinary precautions for safety.* For fear of danger in such employments soon wears off, and some of the men become careless, and they will risk their lives to enjoy a smoke, or to save themselves a little extra labor, and must be constantly watched to prevent them from endangering themselves and their associates.

For, fear of danger being out of the question, men will work as cheaply in such work as any other. They do not consider the work especially dangerous after they understand it, and do not demand extra pay for the risk, nor are they paid anything extra on that account.

Much of such work is of an easy character, requiring from three to eight hours' work per day, and men will choose such situations in preference to jobs where ten hours' hard work per day is required.

The owners and operatives of establishments where explosives are manufactured would heartily concur in any legal enactment, whereby the operations in such works could be carried on more safely, and would like to have any of your correspondents give the outline of such a law. OLIN SCOTT.

Bennington, Vt.

The Nature of Centrifugal Force.

Editor American Machinist:

Mr. Lavery, in your issue of 19th of April, and Mr. Webber, in that of the 26th, seem to regard me as differing from Mr. Porter as to the *facts* in the case of a revolving body, but there is no such difference. We both understand perfectly that the tendency of any such body is tangential, and that on the breaking up of the system the particles follow tangential paths. And I am sure that even if Mr. Porter had not declined to discuss the question further, he would not dispute that as this tangential tendency is continually thwarted by a *centripetal* force, it must needs oppose this thwarting by a "*centrifugal* force," a component of the tangential tendency. Indeed, Mr. Porter says as much, and in almost so many words; giving, for this force, the usual rule for steam pressure in a cylinder; a rule which, in cylinders and wheels, can apply *only* to *centrifugal* forces.

The points at issue were the *propriety of the expression* "centrifugal force," and *that of the definition* of said force as "that with which a body *while revolving* around a center, *tends* to fly off in a radius;" and bearing in mind, that this tendency exists *only* while the body revolves, I fail to see on what ground the expression and the definition can be objected to.

Mr. Lavery, in criticising my sketch, appears to forget that, in order to simplify the subject, I showed *not* a ball held by a string, and therefore describing a circle, but a ball rolling, as on a billiard table, and moving *in straight lines* from point to point. In *such* a case a ball *would* require a blow toward *s*, or some equivalent, to send it to *o*. If the ball were held by a perfectly rigid *string*, *c s*, the point beyond *c* at which its tangential tendency would first encounter the string's interference, would be infinitely near *c*, and therefore the interference might be considered centripetal.

JOHN C. TRAUTWINE, JR.

Philadelphia.

Kaolin and Plaster of Paris as a Boiler Covering.

Editor American Machinist:

Let me give you a word of warning for the benefit of your readers who are likely to try kaolin and plaster of Paris as a boiler covering, in accordance with the suggestion contained in the letter of Mr. Frank C. Smith in your issue of May 3, 1884. Plaster of Paris ought not to be used in such a covering, for the reason that it contains a considerable percentage of sulphuric acid, as shown by the formula $CaSO_4$. If kaolin has the proper non-conducting qualities, it might be used alone with the jute fiber. Mixing the two will not prevent the chemical changes which are sure to occur sooner or later in the boiler covering; free sulphuric acid will be liberated during the decomposition, which will seriously corrode such portions of the shell of the boiler as are in the vicinity of either steam or water leaks. W. M. BARR.

Brooklyn, N. Y.

The Use of Braces in Steam Chimneys in Preference to Sockets and Socket Bolts.

Editor American Machinist:

The letter sent to you by your correspondent in Bath, Maine, and forwarded to me for reply, received immediate attention and reply forwarded promptly. As the subject is comparatively a new one in boiler building, I quote the question in full, and hope it may receive attention from other boiler makers of more experience and better ability than myself, at the same time giving my views to your readers in about the same manner as given in my private letter.

The following is the subject of inquiry: "I would like to ask the opinion of some of your readers who are practical boiler makers as to the comparative merits of socket bolts and flat braces for staying between flue and shell in steam chimneys, as commonly used in towboats, and other such boilers."

The socket and socket bolt have been used for steam chimneys for as long a time as my memory goes back, in connection with the boiler trade, and I think the continuance of the custom up to this time is owing to the fact that the use of sockets for this purpose enables the foreman to utilize a part of the small pieces, so numerous in every shop, which are too large to go into the "scrap pile" and too small to be used for patches. In addition to this, sockets are applied much more easily and economically than the flat brace would be, as the man employed in putting in sockets is, generally, but a handy helper who can form his own sockets; while the braces, generally considered a part of the blacksmith department, require the skilled and costly services of the smith. The distance being equal where the lining and shell of chimney are cylindrically true, there is much care required in the formation of braces, if such are used, while in the case of the sockets, they can be "upset" on the anvil if too long, or "drawn" out on the horn if too short.

In regard to the merits of the socket bolt over the flat brace, as far as strength is concerned there is really no difference between them, if the brace is equal in area to that of the bolt, is properly made and put in, and the rivet at each end is of sufficient diameter to equal the strength of the brace. If the flat part of the brace is put around the circumference of shell and lining, the heel of brace is exposed to the strain imparted by whatever expansion and contraction may take place between the two circles, and may in time become fractured from this cause, as the heel of brace should be formed pretty square, to obtain as much rigidity as possible, and this formation in itself must necessarily result in an imperceptible fracture of the iron fibre. Sockets and bolts are used in preference to braces, for the reason that the space between lining and shell is often insufficient to allow the body of a man to enter, and as rivets must be "held on" by a man of strength, the necessity of using the socket in preference to the brace is apparent. Sockets can be, and are usually, put in without any person entering between lining and shell. This is done by means of a long "spring tongs," which places the end of socket opposite the hole in shell (the socket being held at an angle by the helper); a pin is then pushed through the sheet into the socket, and hammered in whatever direction is necessary until it comes in line with the hole in lining. If found too short or too long, it is removed and altered, or another one substituted. Should the socket be correct in fit, the pin used by the workman is pushed out and a wooden plug inserted, until all the sockets are in, then the bolts and washers are put in, and the job completed.

If bolts were put in as fast as the sockets were fitted, there would be no spring between the plates, and much trouble would arise in getting the sockets in position. By putting in the wooden plug, with sufficient projection inside and out, the sockets can be put in much faster. A good workman and helper can get the length of socket required, form them on a mandrel, and put them in position at about one half of the cost of putting in braces and rivets; so that, while there is no apparent superiority in the brace, the economy of the socket, both in utilizing the scrap as well as in the time required in their insertion, makes the latter the favorite in every case.

The expansion of a steam chimney lining being much greater than that of the shell a vertical strain would of necessity be thrown upon either brace or socket, so that in this respect there is no perceptible merit in either as compared with the other, except it might be in the thread of bolt being already cut and open to fracture from expansion, yet I have never known of socket bolts giving out in the thread or screw.

GEORGE MARSHALL.

How to Extend Knowledge of Cupola Management.

Editor American Machinist:

We have had from all sections of the country accounts in the AMERICAN MACHINIST, of iron melting in foundry cupolas, and while they have in amount of fuel used and iron melted reached every grade of good, bad and indifferent melting, they have all been articles of great interest to foundrymen.

No matter what grade has been given, whether above or below the average, they suggest valuable ideas to every thoughtful moulder, and are of special interest to all who have charge of melting in foundries.

Too much cannot be written on this subject. Foundry firms are paying more attention to this matter than they did ten years ago, as they realize the value of economical melting, and appreciate the services of a man who can take off a heat with a small percentage of fuel, and not have from 300 to 600 pounds of iron left after all the moulds are poured, part of it to run into pig, and the rest, when the bottom is dropped, to come tumbling through in a half melted state, with about a quarter of a ton of coke.

It is astonishing to observe the number of moulders who know nothing at all about management of cupolas or melting. I believe I would not overstep the mark if I should say that number constitutes the majority, and why is it? Certainly it must be from lack of opportunity. We know that there are some "smart Alecks" who, if given a chance to learn, would reply indignantly, "I'm a moulder, I am; not a cupola dauber," and stick their thumbs in the armholes of their vests and walk off. But one cannot imagine that an intelligent moulder would willingly remain in ignorance of one of the most important branches of the foundry business, a branch he must thoroughly understand before he can hope to successfully carry on business for himself, or manage for others.

I wish to say that it depends upon the foundry foremen to change this state of affairs in the future. You ask how? I answer, one way is to give the apprentice boys a chance now and then to go on the charging floor, and do (or help do) the charging. Do not say you want them to skim or light off vents. With a little management you can spare them in turns, occasionally. We have thirty-five hands in our foundry. Four of them are apprentices. I let each of them have a chance at the cupola, and I can tell you they appreciate it, and I hope will profit by it.

Don't be afraid you will overstock the market with moulders who are capable of being foremen. If you are fully qualified for your position you will stay there. Do not forget you was an apprentice once yourself. ROBERT E. MASTERS,

Columbus, Ga. Columbus Iron Works.

Boiler Setting—Dirt in Boilers.

Editor American Machinist:

One of your correspondents suggests that the distance from grates to shell, in a tubular boiler, should be three feet. This I believe to be exactly right for all boilers of this class over 40" diameter. The bridge wall should conform to the curvature of the shell, and be 6" away from it.

In the case of the exploding locomotive boiler noticed in the AMERICAN MACHINIST of April 19, I am of the opinion that the accident could be traced to scale and dirt in the boiler. We used to expect that about 20 boilers of threshing engines would explode out here every harvest season, the reason being that when the boilers got limed up the exhaust nozzles would be contracted, and the fire surface, covered with lime and dirt, would get red-hot, the result being an explosion. I have been in a tight place with these engines myself.

I think your position on patents and patent stealing is just right. The proper protection of patents has a great deal to do with engineering progress. JOHN MAILER.

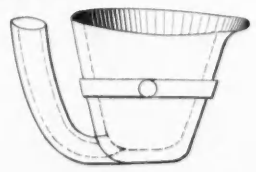
San Francisco, Cal.

Correct or Incorrect Engineering Expressions—A Suggestion for a Foundry Ladle.

Editor American Machinist:

I find a great variety of expressions relating to stationary engines, and it is sometimes puzzling to know which are right. For instance, in getting a new engine ready to start, one engineer comes in and asks: "Is this engine to run over or under?" Another asks if it is to run in or out; and still another, if it is to run forward or back. Which is right, and which is wrong; or are either of the expressions right, or wrong?

Another thing that I should like to know is, what gain is possible in a compound noncondensing engine over a single cylinder automatic engine?



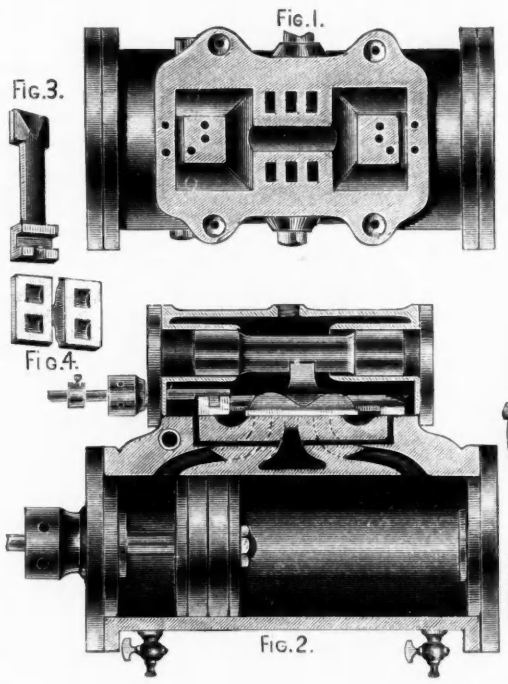
I should like to ask Mr. West how a ladle similar to that shown in the sketch would do to get clean iron from the bottom for fine castings. M. H. P.

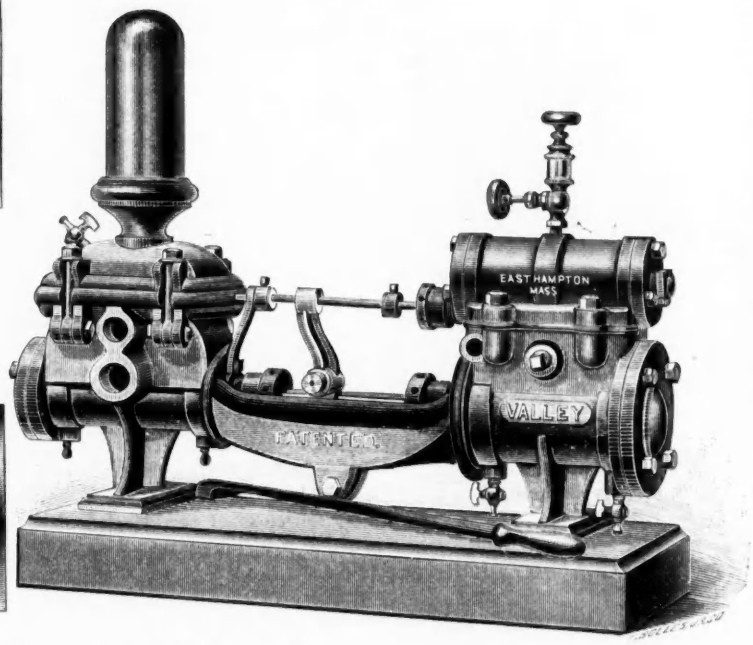
Columbus, Ohio.

P. Lorillard & Co., tobacco manufacturers, have established a library of 6,000 volumes in a suite of three rooms centrally located in Jersey City, which they have presented to their employes. The standard magazines and periodicals are on file at the rooms.

New Direct-Acting Steam Pump.

Simplicity of construction is one of the things to be desired in designing machinery of all kinds, and particularly so in the instance of steam pumps. The Valley Machine Company, of Easthampton, Mass., who are well known as the manufacturers of the bucket plunger and acme fly wheel steam pumps, have begun the manufacture of a direct acting, or automatic valve motion steam pump, which for simplicity they claim is unsurpassed. Referring to the engravings, Fig. 1 shows a plan of the steam valve seats with the ports for both main and supplemental valves, and Fig. 2 shows the steam chest broken away, and the valves in position. Fig. 3 shows the supplemental valve, and Fig. 4 the main valve. The other cut shows the pump as a whole. From these engravings a very correct idea of the construction and operation of the pump may be had.





New Direct-Acting Steam Pump.

A Fast Locomotive.

Doctor Nat Sawyer, a well-known locomotive engineer, who has run many of the fastest timed special trains that ever passed over the New York Central Railroad, says that the "Sam Sloan," now No. 70, is the fastest engine he ever ran, when the load was within her capacity. She could get away with a heavy load, too, for the size of the engine. The engine is 8-wheeled, of the Buchanan ordinary build for the time she was put up. The cylinders are 17x20 inches; throw of eccentric, 5½ inches; steam ports, 1⅛x16 inches, and exhaust port 2¾ inches wide. The driving wheels are 66 inches diameter. This engine, with four or five cars, could run a mile a minute easily, and keep it up, where the track was level. She would swing twelve or fourteen cars along at forty miles an hour, and never fall short of steam. The "Doctor" has a lingering fondness for that engine, and although he now has charge of a handsomely-equipped locomotive, used for taking the Superintendent special over the road, when the question of a smart-running engine comes up, Nat refers to the performances of the "Sam Sloan."

Mr. W. B. Cummings, who has been chief engineer of the Anchor Line steamer City of Rome ever since that vessel was launched, has been appointed inspecting engineer for the company at Liverpool. For several years before joining the City of Rome Mr. Cummings was a draftsman with John Elder & Co., the great shipbuilders of Glasgow, Scotland.

A Small Locomotive.

Hartley & Marshall, miners and shippers of gas and steam coal, Pittsburgh, Pa., have imported a small locomotive engine for use in one of their mines. It is an unusually small machine but carries the intensely high steam pressure of 250 pounds to the square inch. The cylinders are 5×12 inches with three pairs of wheels coupled, the diameter being 18 inches and the total wheel base 7 feet. The gauge of track is 2 feet. The boiler is of steel, the fire-box of copper and the tubes are made from hard brass. The height of engine from the rail is 5 feet 3 inches and the greatest width 4 feet 10 inches.

The New York Central and Hudson River Railroad Company are preparing to run their through fast trains from New York to Albany without stopping. They are putting in more water troughs so that the engines can take up all the water needed for the run without stopping. This is part of a plan for accelerating their whole service of fast trains run over this road.

Locomotive Engine Running—The Valve Motion.

By Angus Sinclair.

SLIP OF THE LINK.

In equalizing the valve motion and overcoming the discrepancy of steam admission due to the angularity of the connecting rod by moving the link-hanger stud away from the center of the slot, a new distortion is introduced. The link block being securely fastened to the bottom of the rocker pin, moves in the fixed arc traversed by that pin, which is nearly horizontal. The action of the eccentric rods on the link on the other hand forces the latter to move with a sort of vertical motion at certain parts of the stroke making it slip on the block. Moving the hanger stud back tends to increase this slip, which will become excessive enough to seriously impair the efficiency of the motion, if not kept within bounds by the designer. Where the slip is very great the motion will not be serviceable, a consideration which can never be overlooked, for the block will wear rapidly, producing lost motion, a very undesirable defect about any part of a link gear. With the long rods which prevail in locomotive practice, designers have no difficulty in keeping the slip within practical bounds, but with marine engines it is sometimes necessary to sacrifice equality of steam admission to the reduction of the slip. The greatest amount of slip is in full gear, and it diminishes as the link block is moved towards the center.

Placing the eccentric rod pins back of the link arc, as is almost universally done in this country, has a tendency to make the link slip on the block, and care has to be taken not to locate these pins farther back than is actually necessary for other requirements of the link motion's adjustment. Auchincloss, who is a recognized authority for designing of link motion gives four varieties of alterations capable of reducing the slip when it is found too great for a practicable motion. His resorts are either to increase the angular advance, reduce the travel, increase the length of link, or shorten the eccentric rods. One, or a combination of these methods may be adopted, as the designer finds most convenient.

RADIUS OF LINK.

Among the constructing engineers who plan link motion, there is considerable diversity of opinion about what radius of link helps to produce the best valve motion. The distance between the center of axle and center of lower rocker pin may be accepted as approximately correct, although some designers slightly increase beyond these points. On the other hand, the locomotives sent out from a leading building establishment, have the radius of link drawn ¾ inch per foot short of the distance between the axle and rocker, and the claim has been made that the arrangement produces an excellent motion.

A committee of the American Master Mechanics' Association have placed themselves on record on this subject by asserting that the distance between the centers of axle and rocker pin is the proper radius for the link. That same committee recommended that the link motion should be planned to give as long a link radius as possible, subject to the first-mentioned conditions.

It must be noted that the middle of the link slot is the radius arc. I knew of a case where the links for an altered locomotive were finished out of the true radius through the edge of the slot being taken as the radius curve.

INCREASE OF LEAD.

Most of men who are at all familiar with the valve motion are aware of the fact that with the shifting link the lead increases as the link is notched towards the center. Where the valve has $\frac{1}{16}$ inch lead in full gear it is no unusual thing to find it increase to $\frac{3}{8}$ inch lead opening at mid gear. The phenomenon is better known than its cause is understood.

The relative positions of link and eccentric centers of an engine when the crank is on the forward center are shown in Fig. 1, the link being represented with the block in the center, which represents mid gear. It will be observed that the centers of the eccentrics *f* and *b*, from which the rods receive direct influence, are both some distance ahead of the centre of the axle, the one above, the other below. The eccentric straps to which

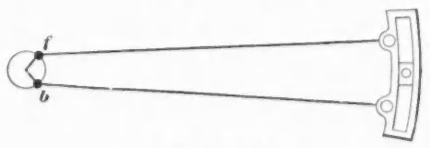


Fig. 1.

the rods are connected sweep round the eccentric circles, and are controlled thereby. When the link is moved up or down, each eccentric rod pin, where it attaches to the link, describes the arc of a circle with a radius drawn from its own eccentric. If both rods were worked with a radius from the axle center, the link could be raised and lowered when the engine stands on the dead center, without moving the rocker pin at all; but under the existing arrangement the link is influenced directly by one or other of the eccentrics, whatever position in the link the block may stand. When the engine is standing on the forward center, with the link in mid gear, as shown in Fig. 1, it will be readily perceived that the block stands at its farthest point away from the axle, for the rods are so placed to reach their greatest horizontal distance ahead, and consequently in this position the lead opening is greatest. If the link be now lowered the backing eccentric rod will immediately begin to pull the link back, and as the pin of the forward eccentric rod approaches the central line of motion it will also keep drawing the link back, so that by the time the link is in full gear the lead opening will be considerably reduced.

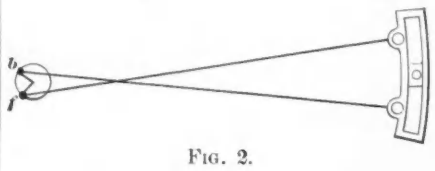


Fig. 2.

When the engine stands on the back dead center, as shown in Fig. 2, the eccentric centers will be on the other side of the axle, and the eccentric rods will be crossed. While in mid gear, the link block is drawn closer to the axle than it would be in any other position of the link, and consequently the lead opening is greatest. If the link be now lowered the forward eccentric rod will approach its horizontal position, and consequently reaches farther on the central line of motion so it will push the link block away from the axle, thereby decreasing the lead. Pulling the link into back gear has a similar effect.

The tendency of a link motion to increase the lead towards the center is made greater by shortening the eccentric rods. Increasing the throw of eccentric inclines to accelerate the lead towards the center, since it throws the eccentric centers further apart. For slow-running, hard-pulling locomotives, where increase of lead is a disadvantage, the tendency to increase the lead is sometimes restrained in forward gear by reducing the angular advance of the backing eccentric. This expedient is, however, not necessary where proper care and intelligence have been bestowed in the original design of the motion.

In studying this part of the valve motion, a young machinist or engineer will obtain valuable assistance by cutting a link template out of a piece of pasteboard and using strips of wood as eccentric rods. With these he can test on a drawing-board or table the various positions of the link, and note in a way that is easily understood the effect of changing the link into different positions.

A correspondent of the *Mexican Financier* draws attention to an expensive mistake made by mine managers in certain districts of erecting machinery far too heavy for the requirements of the mine. There is a prejudice in favor of ponderous Cornish machinery, which is transported and erected at enormous expense, the result being in many instances financial ruin to the smaller stockholders. Light engines, hoisting and pumping machinery would, in many cases, be more suitable for the needs of new mines, and they could be operated cheaper, besides costing less than the imposing paraphernalia in vogue.

The government of India, which controls and operates the greater part of the railway system of that country, has determined to adopt iron freight cars, and it is advertising for contracts to furnish 1,000 cars made of that material. The specifications published show that the American freight car design has directly influenced the plans for the new Indian goods wagons, as they are called. They will be open cars twenty-five feet long, and will be carried by two trucks. The whole of the cars will be of iron—trucks, frames, and upper work. All parts must be made interchangeable, and to standard sizes.

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NEW YORK, MAY 17, 1884.

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An Act of Congress to Discourage American Shipbuilding.

There is joy throughout the free trade camp of the United States, and that portion of the press which sees no reason why artificial means should be used to maintain our industrial prosperity is jubilant over the passage by the House of Representatives of an act permitting certain ships of foreign build to be registered under the American flag. The bill in itself is a small affair, since it merely permits the free importation of iron and steel ships exceeding 4,000 tons register, to be used for foreign-going commerce only. The foreign carrying trade is so depressed at present that there is no likelihood of any new line being started, even with the stimulus of free ships. The true animus of the bill lies in the principle which has gained a victory, for it is nothing less than a step in the direction of free trade, and the victory for the foreign shipbuilder means a defeat for our own struggling shipbuilders. A leading supporter of the measure defined the situation correctly when he publicly proclaimed it as "a great triumph, not all we could wish, but still a step in the right direction."

Every lover of American progress and friend of the country's prosperity deplores the depressed condition of our mercantile marine; but those who have studied the matter most industriously are agreed that our loss of prestige as ocean carriers is not to be regained by any free-ship bill. The causes that prevent our yards from building ships as cheaply as they are turned out on the Clyde or Tyne, militate against us as a carrying nation, and unless American shipowners are given some special privileges to put them on a footing with their British rivals, we will never regain our lost place on the ocean. Before losing the great mass of our shipping through the misfortunes and necessities of the war, we carried eighty-four per cent. of our own commerce; but during the season of our adversity British shipping interests got a start of ours, which was judiciously accelerated by government subsidies and other artificial means that our free traders abhor so much when applied to foster American interests, so that now we do not carry more than fifteen per cent. of our own trade. For a few years after the close of the war, our shipowners made a struggle to regain the position they had lost; but they were so weighted down by heavy taxes, oppressive dues, and higher-priced labor, that they were forced to yield. They were no sooner vanquished in the foreign carrying trade, than British shipowners began intriguing to get a share of our coasting trade, and the annual effort made to pass a free-ships' bill is the point of the wedge which is intended as a means of splitting up our remaining shipping trade. This effort has been carried on so persistently that success will follow sooner or later, unless the friends of our native industries bestir themselves to defeat the scheme. Success to a certain extent has been already gained by the enemies of our native industries, who are continually agitating in favor of free ships, for it has tended to frighten American capital away from shipbuilding enterprises. To the labors of those who are striving so zealously to make foreign shipbuilding yards prosperous at our expense, may be traced some of the mysterious attacks so incessantly directed against the new American Shipbuilding Company; and the groundless enmity continually expressed against other shipbuilding interests seems to have a similar origin. Under very adverse circumstances our shipbuilding firms have persevered in following their business, till iron or steel ships can be built on the Delaware to-day as good as anything launched from the best British yards, if the buyer is willing to pay the American labor which does the work. The free-ship bill is an outrageous attempt to place our shipbuilders at a disadvantage with their foreign rivals, for anything that can be said in favor of free ships is equally cogent in favor of free shipbuilding material. If these scheming agents of British shipbuilders were honest in their pretensions of wishing to aid the growth of our mercantile marine, they would first propose to give our own shipbuilding yards the encouragement of free material to work on. This policy they try to reverse. If it is carried out, it will in a few years close every iron shipbuilding yard in America.

Can Alloyed Metals be Separated by Pressure?

Some months ago a statement went the rounds of the technical press in Europe and America, to the effect that J. & W. Weems, makers of gas pipes, of Glasgow, Scotland, had attempted to draw brass tubes in the way pipes are made from lead, and that the enormous pressure to which they subjected the brass separated the zinc from the copper. This separating of combined metals by pressure was regarded as an important scientific discovery, and it was cited as a practical demonstration of the truth of the atomic theory of matter.

Mr. John Robertson, of Water Street, Brooklyn, was well acquainted with Mr. Weems, who claimed to have made a success of separating the metals by pressure, and while visiting Scotland, Mr. Robertson questioned Mr. Weems about his mode of operating to obtain the high pressure used. Mr. Weems said it was done in a cast-iron cylinder with a wrought-iron ram. As Mr. Robertson, during the course of his business as a maker of hydraulic machinery, has enjoyed unusually good facilities for making tests with high pressures, he at once declared that Mr. Weems was mistaken, since he had subjected brass to a higher pressure than it was possible to reach with the means employed by Mr. Weems, without meeting with any indication of the metals separating. Since that time Mr. Robertson has been experimenting in his works at Brooklyn with different metals, subjecting them to the highest pressures the best hardened steel will impart. He uses a steel cylinder and hardened steel die, and in numerous instances he has raised the pressure till the end of the die has flattened out. A two-inch die, which we examined in this condition, stood a pressure of 9,990 tons to the square inch before it yielded. A brass cap, which had been squeezed out of a disk under this pressure, showed no indication of the zinc separating from the copper. Mr. Robertson holds that a substance stronger than steel will be needed to raise the pressure which is going to separate fused metals, and he confidently asserts that the feat has never been done.

The list of candidates to be voted upon for admission to the American Society of Mechanical Engineers at the Pittsburgh meeting, May 20th, reaches over 125 in number. We notice that the applicants reside in twenty different States of the Union, also in the District of Columbia, and Glasgow, Scotland. The list includes a number of well-known engineers.

It seems a little hard for locomotive engineers on Texas railroads to regulate their noise to the requirements of every town they pass through. The municipal authorities there claim the right to dictate whether tumultuous noise or quiet shall prevail while trains are passing through the town limits. Accordingly the matter is regulated according to the tastes of the different towns. One town called for the ringing of the locomotive bell all the time the train was passing, and the next town did better by calling for the whistle to be sounded through the whole city limits; but a third town more enterprising still demanded both whistle and bell to be used in passing its borders, a rule which of course was duly observed. Others again are of a retiring disposition and do not want the whole world to know when each train is passing through the city, so they will have no whistling or bell ringing within their limits. As the city authorities are not limited in changing their orders, they occasionally change from noise to silence for a few days and *vice versa*. In order that the varying wants of the city fathers may be duly respected, the railroad managers of Texas are considering the propriety of issuing daily bulletins as to the requirements of the various towns for noise or silence.

A leading difference in the position of the American and of the European artisan is that the former claims enough remuneration for his day's labor to keep himself and family respectably fed, clothed, and educated without assistance. In every European country an artisan is exceptionally well paid who can rear a family without sending the children to work at an age when few American children are expected to do any labor. In many cases not only the children of foreign workmen have to toil early and late, or go part of the time hungry, but often the mother has few hours a day for household duties, her time also being devoted to incessant unwomanly toil in the hard struggle for existence. Those who are striving to demolish our protective fabric wish to put the produce of our workmen in competition with the goods produced in countries where men cannot earn a family's livelihood by their labor. There will be some noise in free America before the reducing policy that will place our people on a level of that kind is completed.

If powder manufacturers are as careful in providing safeguards for workmen as appears from the communication of Olin Scott on page six, they cannot certainly object to a rigid Government inspection.

Literary Notes.

FOUNDATIONS AND FOUNDATION WALLS for all classes of buildings, pile driving, building stones and bricks, pier and wall construction-mortars, limes, cements, concretes, stuccos, etc. Sixty-four illustrations. Practical explanations of the various methods of building foundation walls for all kinds of buildings. Tables of the weight of materials, etc., the kind of materials used, the loads sustained, and the sizes of wall piers, etc. Use of plastering, mortars, limes, and cements. Extracts from New York building laws, with notes. By George T. Powell, architect and civil engineer, New York. To which is added a treatise on foundations, with practical illustrations on the method of isolated piers, as followed in Chicago. By Frederick Bauman, architect. Revised and enlarged by the addition of much new matter by G. T. Powell. New York: William T. Comstock, publisher, No. 6 Astor Place. Price, by mail, postage free, $2.

This is an interesting and instructive book for those in search of information on the subjects treated, and is also a good reference book for those not directly interested.

One of the live, newsy and progressive technical journals on our exchange list is the *Mining Herald and Colliery Engineer*, published weekly from Philadelphia and Shenandoah, Pa. In the issue of April 19th the explosion in the Pocahontas mine is treated (by the aid of a diagram) and its cause discussed. Subscription $2 00 a year.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(199) J. H. B., Greenville, O., asks: Which will be the more economical fuel to use in an upright boiler, coal or coke? *A.*—We should say that coal would be.

(200) H. L. Milwaukee, Wis., writes: I have an engine 3″x4″ which I should like to put into a boat 20 feet long. How fast would it propel such a boat with 90 lbs. boiler pressure? *A.*—Probably about seven miles an hour.

(201) E. S. H., Meadville, Pa., asks: Can you give me a general rule for determining the diameter and weight of fly-wheels for steam engines? *A.*—There is no general rule for diameter of fly-wheel. A very good practice is to make the diameter not less than four times the stroke of the engine, when circumstances will permit. You will find a rule for calculating weight of fly-wheels in the AMERICAN MACHINIST of May 13, 1882.

(202) W. S., Sherbrooke, Quebec, asks: Is there a standard for the taper of plug cocks; and, if so, what is it? *A.*—There is no recognized standard. The taper varies, usually between 1″ in 4″ to 1″ in 6″.

(203) H. M. S., K——, Ind., asks: Who invented the steam-engine governor, and when was it invented? *A.*—So far as we know, it was invented by James Watt, a little more than one hundred years ago.

(204) M. S., Hartford, Conn., asks: Will you give me a rule for proportioning cone pulleys? *A.*—See AMERICAN MACHINIST of February 5, 1881; October 15 and 22, 1881; November 26, 1881, and February 25, 1882.

(205) A. M., Roanoke, Va., asks: Is it desirable to have a projectile with the following points: Increased rotation without change to the gun, high velocity, a very flat trajectory, and greater penetration? *A.*—The last three qualities are desirable ones; the first is perhaps well enough provided for already.

(206) R. G., Memphis, Tenn., asks: What is the customary rating of an engine 22″x32″ running at 75 revolutions, cutting off at ¾ stroke, boiler pressure 80 lbs.? *A.*—There is no generally-followed custom in this respect. We should say such an engine, if well constructed, would be fairly rated at two hundred indicated horse-power.

(207) Ignorance, Wilkesbarre, Pa., writes: I have had an argument with a gentleman in regard to patent laws. I claim that a person is free to manufacture and use a patented device; a bicycle, for instance, or anything he will use for pleasure rather than for profit. My friend says no. Which is right? *A.*—Your friend is right.

(208) J. B. H., Atvon, Mich., sends sketch of exhaust pipe, in which are three elbows, the general direction of the pipe being down, and asks: Will putting up the pipe in that way make any difference with the power of the engine, which is 12″x18″, running 160 revolutions per minute? *A.*—Make the exhaust pipe not less than 4″ diameter and you will have no trouble from the elbows. The back pressure will undoubtedly be slightly, but not materially, greater than if the pipe were straight.

(209) W. S. B., Baltimore, Md., asks: Will you tell me if a horizontal engine should be counterbalanced the same as a vertical engine, making allowance for the entire weight of the reciprocating parts? *A.*—Different considerations are required in balancing the two classes of engines, and it is a difficult matter to determine, except by experiment, just how to accomplish the best results in counterbalancing. The subject was quite exhaustively treated by Professor Robinson, in a paper read before the American Society of Mechanical Engineers, which you can find in the AMERICAN MACHINIST of November 5 and 12, 1881.

(210) J. A. F., Knoxville, Tenn., writes: I am going to set an engine 12″x24″ to run 125 revolutions. I can get full-size stones, say 12″ thick, and had thought of starting foundation with 12″ concrete, then a stone considerably longer than bed, using three stones, battering back to nearly the length and width of bed. Will this make a good foundation? *A.*—This will make an excellent foundation, if you get fairly good ground to work from. You can get a good foundation by building up all but the upper stone of small stones and cement, the whole being considerably longer and wider than the bed, putting cast-iron anchor plates at the bottom for the hold-down bolts. If you use the three stones 12″ thick, anchor the bolts top of the concrete, under the lower stone.

(211) C. T., Brooklyn, N. Y., writes: Edwards, in Modern American Marine Engineering, page 51, gives a rule for boiler power as follows: "Speed of piston in feet per minute × by area of cylinder in feet × by number of cylinders × 60= the cubic feet of steam per hour; and this ÷ by the specific volume of steam at the given pressure = cubic feed of water required; and the cubic feet of water required × 62 and ÷ 9 and × 22 equals the square feet of fire grate required." I have taken the specific volume of steam for 80 lbs. pressure as 333, but cannot get a satisfactory result. Will you please inform me where I am mistaken? *A.*—We see no reason to believe you have made any mistake. On the contrary, we think the author has made a mistake.

(212) J. C. W., Louisville, Ky., asks: How shall I proceed to lead lap holes in the parts of locomotive link motion that are to be hardened? how many mandrels should be used if, for instance, a hole is 3-64″ out, and is there any better way than this for truing the parts? *A.*—Lead lapping is not appropriate for correcting errors so large as that noted. Where hardened bushes, thimbles, etc., are extensively used they are trued up after hardening, by the use of a grinding machine, using small emery wheels. Lead laps for holes are made by casting lead on a mandrel several times—say five or six—longer than the hole, the mandrel being about ¼″ taper to the foot, and having a groove planed or milled in it to prevent the lead from turning around. The lead, about 3-16″ thick, is turned off, then as it wears in use, driving the mandrel further in will enlarge the lead. About No. 60 emery is used, the mandrel being run at high speed.

BUSINESS SPECIALS

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Patterns & Models, G. D. Lambert, New Haven. Ct.

Presses & Dies, Ferracute Mach. Co., Bridgeton, N. J.

Steel Name Stamps, &c J. B. Roney, Lynn, Mass.

Interchangeable work a specialty. Send stamp for new Lathe Catalogue. E. O. Chase, Newark, N. J.

INVENTIONS perfected, designed, or patented. E. P. Robbins, M. E., Cincinnati, O.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John street, N. Y.

Fine tools and special machinery. Horace Thurston, 84 Clifford street, Providence, R. I.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn

Wood Engraving done in best manner. Designs furnished. Edward Sears, 48 Beekman St. New York.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Patents.—Franck D. Johns, Att'y at Law & Solicitor of Patents, 617 Seventh St., Washington, D. C.

Pattern and Brand Letters. Vanderburgh, Wells & Co., corner Fulton and Dutch streets, New York.

Universal grinders for lathe-centers, chucks, angles, or cylinders. C. C. Hill, 84 Market st., Chicago, Ill

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 626 E st., Washington, D. C.

National and box chucks, foot and power lathes, and slide rests. Lodge, Barker & Co., Cincinnati, O.

For Sale—The patent on a new and very efficient dynamo-electric machine, for plating or lighting. A. S. Kimball, Box 522, Worcester, Mass.

Split Pulleys at low prices, and of same strength and Appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

Improved Tack Machinery, made by The Willets Man'f'g Co., can be seen in operation at their works, 57 Clifford St., Providence, R. I.

The "Wax Process" Engravings shown in the AMERICAN MACHINIST each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

Coarse or difficult screws, worms, cutters, taps, rotary files to order. Machinery invented, made. Tower Machine Works, E. Brookfield, Mass.

New Books, relating to steam, the steam engine, mechanics, machinery, and engineering. Send for catalogue. Fred. Keppy, publisher, Bridgeport, Conn.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 62 Chatham St., N. Y.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,300, New York City.

"Catechism of the Locomotive."

The most complete and easily understood treatise on the locomotive; 625 pages, 250 illustrations $2.50. For sale by "The Railroad Gazette," 73 Broadway, New York.

EXTRACTS FROM CHORDAL'S LETTERS, 400 pages, 12mo., handsomely bound in cloth. New and enlarged edition, with over 50 illustrations. Price $2. Published by John Wiley & Sons, 15 Astor place, New York.

Useful Information for Steam Users—A 100-page pamphlet, compiled from the best authorities, on the care and management of the steam engine and boiler, with hints and rules for engineers and firemen. Engineers everywhere should have this work. Send 25 cents in P. O. stamps for a copy. The J. N. Mills Publishing Co., 145 Broadway, N.Y.

MANUFACTURES.

W. C. Turner, Milan, Tenn., will build a cotton-seed oil mill.

Webster, Dak., wants a grist mill; also a machine shop and foundry.

The Griffin, Ga., cotton mill is nearly completed, and will start about July 1.

The Locust Point Land Company, of Baltimore, will erect a new machine shop.

The Lock and Hardware Manufacturing Company has been organized at Lexington, Ky.

Charles H. Eggert, Brooklyn, N. Y., will erect a three-story brick factory on Atlantic avenue.

Nearly all the carpet mills of Philadelphia are working from one-third to one-half capacity.

The Collier White Lead Company will erect a factory on 23d street, Philadelphia, to cost $26,000.

T. Sessinghaus will erect a $20,000 flour mill in Philadelphia, corner of 2d and N. Market streets.

Morris & Ott will erect a three-story cotton factory on Howard street, near Apple street, Philadelphia.

Brandon, Minn., has subscribed $500 toward procuring a grist and saw mill combined, at that place.

The Peninsular Car Company, Detroit, Mich., will erect twelve shops, on Ferry street, to cost $90,000.

Manwell & Crabtree, Newberne, N. C., whose machine shops were lately burned, will rebuild at once.

The Laclede Car Manufacturing Company, St. Louis, is building an addition to its works, 60 by 118 feet.

Buildings for the Halew Screw Works, to be erected on Pearl street, Syracuse, N. Y., will cost $14,000.

The Sam Cupples Wooden Ware Company, of Philadelphia, will erect a four-story factory, to cost about $32,000.

Several large new shops are to be erected this year by Foote & Johnson, carriage manufacturers, at Whethville, Va.

The Enterprise Machine Works, Geneva, O., have been purchased by new parties, and will be set in operation at once.

Incorporated in Johnson City, Tenn.—The Johnson City Foundry and Machine Works. Capital stock about $30,000.

The Baldwin Locomotive Works, Philadelphia, are building thirty-eight engines for Brazil and the Argentine Republic,

The Spang Steel and Iron Company, of Pittsburgh, recently rolled a boiler head 106 inches diameter and ⅝ of an inch thick.

The stove moulders of Troy, N. Y., have accepted a reduction of 20 per cent., which means that the stove trade is quite dull.

The Millburn Gin and Machine Company, of Memphis, Tenn, has occupied its new works, on which nearly $100,000 has been spent.

Morenci, Mich., wants a roller flour mill, and offers $3,000 to any person who will construct a mill of that description in that village.

The Equitable Improvement Company, New York, will erect a ten-story brick flat at 50th street and Madison avenue, to cost $425,000.

It is stated that at least $1,000,000 will be invested in buildings and factories in Knoxville, Tenn., this year, as against about $750,000 last year.

Works for the manufacture of agricultural implements, boilers, shafting, etc, are to be erected by the Murfreesboro (Tenn) Machine Works Company.

A new company, called the Pacific Barbed Wire Company, has been formed and are erecting works at the corner of Eleventh and Gratiot streets, St. Louis.

The Phillips & Buttorf Manufacturing Company, of Nashville, Tenn., have added $250,000 to their capital, to build the new stove foundry at Birmingham, Ala.

The Long & Allstatter Company, of Hamilton, O., are erecting an extension to their present works, 50x50 feet, and adding to their main building one story 150x50 feet.

The Helmbacher Forge and Rolling Mill Company, of St. Louis, have contracted with the Niles Tool Works for a special crank-boring machine, weighing thirty thousand pounds.

The new machine and boiler shops to be erected for the H. A. Ramsey Company, Baltimore, will employ several hundred hands. There will be several buildings, each 46x100 feet.

Walker & Elliott, machinists, of Wilmington, Del., are building a large two-story brick shop, on the corner of 2d and Lombard streets, to be occupied as a machine shop by the firm.

Thomas H. & Z. H. Withers will erect a foundry and machine shops at Marietta, Ga., for the purpose of making engines for gold-mining and mill machinery, saw and planing mills.

The Rhode Island Locomotive Works are employing about four hundred men. Times are dull at the works, the force being on eight hours a day, and even at that men are being laid off occasionally.

The amount necessary to build a large cotton mill at Roanoke, Va., has at last been raised, and the mill will be built. They are now proposing to establish an agricultural implement factory at Roanoke.

The Waltham (Mass.) Watch Tool Company has organized a new corporation, called the Waltham Watch Company. The new concern has purchased two acres of land upon which to erect a large watch factory.

H. A. Haralson, of Selma, Ala., has received an offer from Northern capitalists to put $200,000 into a new cotton mill, provided the business men of Selma will raise an equal amount. Negotiations are pending.

The Trenton (Tenn.) Cotton Mills is a new corporation. The organizers are: J. W. Hays, J. M. Senter, J. W. Elder, S. J. Taylor, and others. The necessary cash has been subscribed to build the mills and purchase the machinery.

S. B. & M. Fleisher, 26th and Hamilton streets, Philadelphia, have ordered over 400-horse power boilers of Zell & Burton, Baltimore. L. B. Eaton, the general sales agent for these boilers, has opened an office at 22 Cortlandt street, New York.

C. Carman, of Philadelphia, has a contract to erect four factory buildings, at 3d street and Columbia avenue; one to be 52x203 feet, three stories, and the others each one story, will be 110x180 feet, 63x168 feet, and 47x42 feet, respectively.

William J. Hooper & Son, of Baltimore, Md., large cotton manufacturers, have purchased the Mountain Island Cotton Mills, in North Carolina, for $125,000. They will enlarge their mill capacity, and probably spend about $75,000 for machinery.

The Knoxville (Tenn) Woolen Mill Company has been incorporated with $100,000 capital—all subscribed. Incorporators are: C. J. McClung, C. M. McGhee, E. J. Sanford, J. D. Cowan, and R. P. Gettys. Work on buildings will probably commence about May 1st.

Out of the twenty-five blast furnaces on the line of the Philadelphia and Reading Railroad, between Philadelphia and Pottsville, nineteen are now out of blast. The following are in blast: East Conshohocken, 1; Pottstown, 1; Birdsboro, 1; Reading, 2; Pottsville, 1.

F. W. Siddon, H. M. McNutt, Joseph F. Johnson, of Birmingham, and others, have organized a $200,000 company, to build a foundry in Atlanta, Birmingham, Selma, or Sheffield, to manufacture grates, mantels, and hollow-ware.—*Baltimore Manufacturers' Record.*

The Columbus (Ind.) Lock Nut Company has been formed, with $15,000 capital, to manufacture the Gilmour nut-lock. Colonel Horace Scott is president, J. D. Lyle treasurer, Frank Matson secretary, and John Gilgour, the inventor, superintendent. Operations will soon begin.

The Thompson & Nathanson Boring Tool Company, of Milwaukee, Wis., report business good. They are full of orders, and are making arrangements to enlarge their works, and will consolidate their shops at Rockford, Ill., where part of the works were moved six months since.

The contracts for building the Scott Printing Press Works, at Plainfield, N. J., have been given to J. W. Pangborn. The grading is finished. The railroad track is being put into the premises. The foundation for the machine shop is laid. The entire works are to be finished August 1st.

The United States Stamping Company, at Portland, Conn., have decided to rebuild. The contract for a building one hundred and forty-six feet long and eighty feet wide, one-story high, has been given. This property was destroyed by the recent bursting of a dam in that locality.—*Boston Jour. of Commerce.*

St. Joseph, Mo., has raised $45,000 for the Des Moines, Iowa, and Southwestern Railroad. This amount was raised to induce the road to make St. Joseph their southwestern terminus, and to locate their machine shops in that city. The city gives right of way and grounds for depot and machine shops.

The American Watch Tool Company, Waltham, Mass., is driven to its full capacity. Since January 1 they have put in a new Brown & Sharpe milling machine, two Pratt & Whitney lathes, and two lathes of their own make, besides other tools. The prospects are that they will be obliged to build an addition to their shops.

The Houston, East and West Texas Railroad Company offered to extend its road from the present terminus to Shreveport, La., provided that city would give $50,000 and the right of way and grounds for station and shops. The proposition has been accepted, and work will be begun at once at Shreveport and Nacogdoches, Tex., the present northern terminus of the line.

A company has been organized in Boston, called the Equity Tube and Pipe Company (limited), to manufacture wrought iron pipe and boiler tubes of iron and steel. Harvey K. Flagler is president and George C. Hill treasurer. Capital stock $450,000. The works are being erected on Saratoga and Pope streets, under the direction of Mr. Flagler, who for many years was connected with the National Tube Works.

The *Mount Desert* (Me.) *Herald* says: The discovery of asbestos here seems to be something new, and we hope it may prove of importance also. It lies in perpendicular sheets or seams in the rocks, and resembles the roots of the yellow birch on the surface, with bunches of mica scattered in the rocks; the groundwork being composed of serpentine, which, taken together, forms a fine appearance when removed.

At a stockholders' meeting of the Missouri Car and Foundry Company, St. Louis, on the 15th of April, it was decided to raise the capital stock from $500,000 to $600,000. All of the increase has been subscribed for and paid. The company report a gratifying number of orders on their books. The St. Louis and San Francisco Railway Company recently placed an order with them for one hundred box cars, one hundred stock cars, and one hundred coal cars. They are also building three hundred refrigerator cars for various companies.

The Portsmouth, N. H., Machine Company occupies the site of the Kearsarge Manufacturing Company's mills, and has rebuilt, and is putting in machinery for one of the most complete machine shops, foundry, and boiler shops, and engine rooms, to be found in the State. The main building is 204x70 feet, and two stories high: wings 100x30, foundry 146x146, and boiler shops 164x55. Railway tracks pass each side of the establishment, giving superior shipping facilities, with freight depots close at hand. This company is a recent organization, with Hon. Frank Jones, president, C. H. Mendum, treasurer, W. H. Hackett, clerk, and Nathan Whalley, superintendent.—*Boston Commercial Bulletin.*

There are various ways to order constructive material. One way to specify quality is, that it shall be "first-class in every respect," which apparently means a great deal, but in reality is gloriously indefinite. What one concern considers "first-class" is regarded as quite ordinary by another. Here is an example of the definite way to place an order: The Babcock & Wilcox Company, in ordering 500 tons of open-hearth steel from a Pittsburgh establishment, require that a coupon shall be attached to each plate, which shall show 55,000 to 65,000 pounds tensile strength, with 20 per cent. elongation in 8″, to stand bending double both before and after being heated and plunged into cold water, without showing any cracks, and the analysis is not to show to exceed 8-100ths of one per cent. phosphorus. Steel is to be branded and stamped, "60,000 lbs. T. S."

Machinists' Supplies and Iron.

NEW YORK, May 1, 1884.

There is no notable change in the business of machinist supplies since our last report. Dealers continue with one voice to complain that prices show no tendency to improve, although the amount of business moving is considerable. Steam supplies are rather more active than they have been for some time, but prices are still low.

The demand for boiler-makers' supplies is quiet, prices unchanged:

Boiler Plate—Common.....2 4-10c.
Refined.....2 6-10c.
Shell.....3 1-10c.
Flange.....4 1-10c.
Extra Flange.....5¼c.
Chester Steel.....5¼c.

Iron, pig, American—The business reported during the week does not indicate any material change in the range of values or in the temper of the market. We quote No. 1 XFoundry, $20 to $21.50; No. 2 X Foundry $18.50 to $19.50; Grey Forge, $16.50 to $17.50.

Scotch—The market appears to be demoralized, the demand being slow and sales difficult, at prices that will cover the cost of importation. Dalmellington, to arrive has been offered at $19.50; Eglinton, $19 to $19.50, and Coltness at $21.70. The ordinary quotations all show a downward movement.

Tin—The demand has been moderate and prices ruled steady. Banca, 20¾c.; Straits and Malacca, 19c.

✻WANTED✻

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Foreman boiler maker, thoroughly posted, wants position. Satisfactory references. Address BOX 8, AM. MACHINIST.

Wanted—Situation by machinist, well posted in celluloid machinery, etc. Address H., AM. MACH.

Wanted—Situation, by a young pattern maker. Address C. D., AM. MACHINIST.

First-class mech. draughtsman desires situation. Address A, 125 Clark street, Room 40, Chicago, Ill.

Norman W. Wheeler is free to engage for iron ship building and engineering, in July. Present address, Bath, Me.

First-class pattern maker wants situation; on machine work preferred. Address Box 379 South Norwalk, Conn.

Situation wanted, as foreman of a boiler shop. Have had 20 years' experience as foreman, and am conversant with marine stationary and locomotive work. Address George Marshall, care AMERICAN MACHINIST.

Wanted—Position as mechanical superintendent of shop, on light machinery or specialties, in iron or brass. Am experienced in the economical management of help, also in designing and constructing tools for the rapid production of work. Can furnish first-class references for character and ability. Address D. D., Box 7, AM. MACHINIST.

Situation wanted -By a foreman blacksmith, familiar with drawings and details, reverberatory furnace, steam hammer, marine and stationary and locomotive engine work, machine and job repair work—work up all scrap possible—good executive ability, reliable habits. First-class references given. Address A. B. C, care of AM. MACHINIST office.

The advertiser, who represents a new, important, and rapidly-growing industry, desires to correspond with a few intelligent mechanics or steam engineers, whose education and experience has fitted them to quickly learn the peculiarities of the business, with a view of placing them in charge of special branches. The positions are responsible ones, and require five competent and reliable men, of good character, habits, and address, with some knowledge of business and draughting, and experience in handling men. Address, giving age, acquirements, special experience, whether married or single: and references, Box 12. AM. MACHINIST.

For sale, at a bargain—Half or entire interest in foundry and machine shop, in a good town, in western part of State, doing good business. Address E. H. Hastings, 5 Bowling Green, New York.

FOR SALE—Harris-Corliss horizontal condensing double engine, cylinders 20x42 and 18x42. Wheel 16 feet diameter and 39 inch face. In good order; replaced by larger engine.

To be seen at Planet Mills, 372 President street, Brooklyn, N. Y.

NOTES IN MECHANICAL ENGINEERING.

Compiled principally for Students, but also of great value to all Mechanical Engineers. By HENRY ADAMS. 93 pages, 12mo, $1. Descriptive Catalogue (100 pages) free

E. & F. N. SPON, 35 Murray St., N. Y.

MACDONALD'S HYDROSTATIC Level

LEVEL LINE INDICATED BY WATER.

For leveling all kinds of Machinery and Structures, or points separated by long distances and obstructions.

JAS. MACDONALD
55 BROADWAY, NEW YORK

HILL, CLARKE & CO.

36 OLIVER STREET, Boston, Mass.
BRANCH OFFICE, 800 N. 2nd STREET, St. Louis Mo.

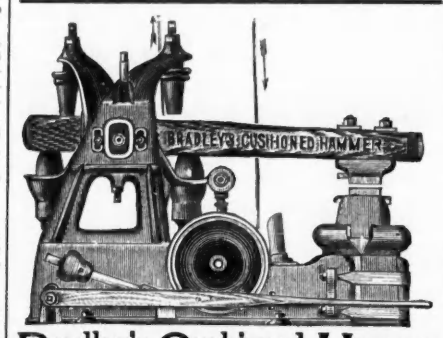
Have just issued new

CATALOGUE

—OF—

LIGHT MACHINERY & SMALL TOOLS.

Sent free to Manufacturers and Dealers on receipt of their business card.



Bradley's Cushioned Hammer

Stands to-day WITHOUT AN EQUAL.
OVER 800 IN USE.
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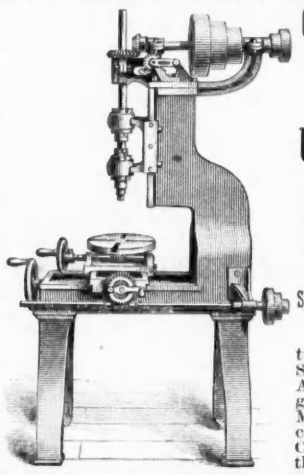

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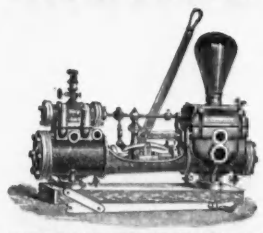

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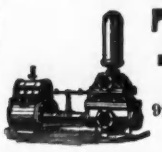

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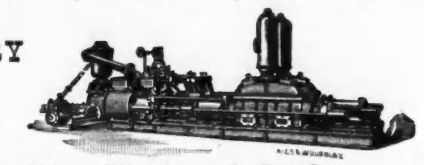

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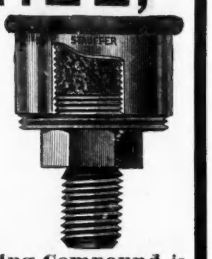

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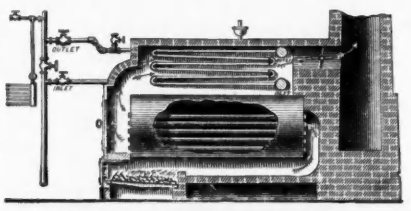

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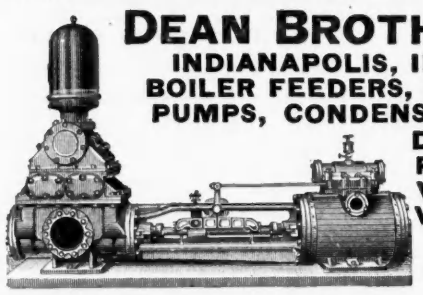

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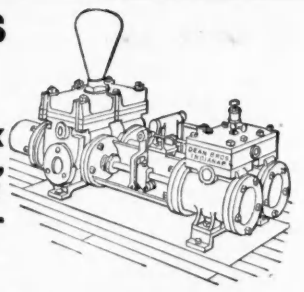

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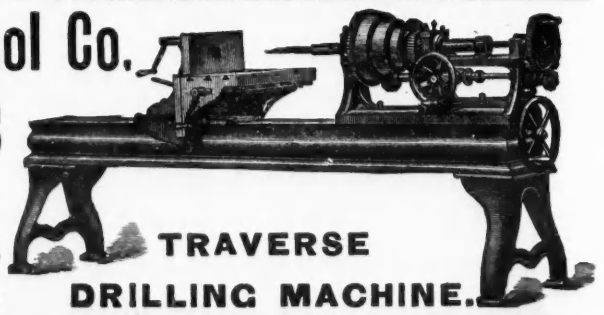

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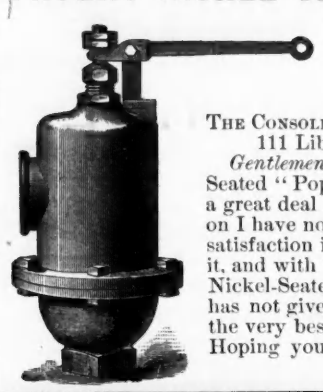

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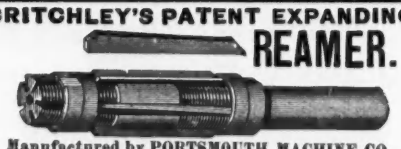

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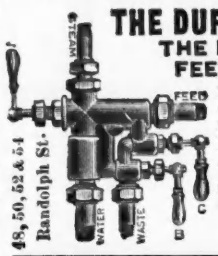

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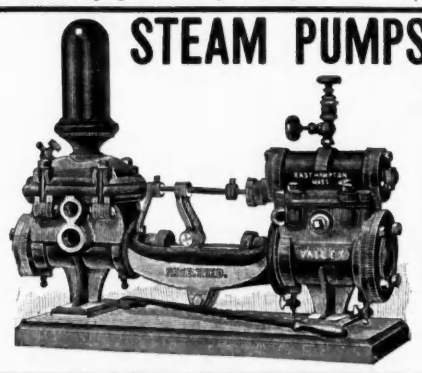

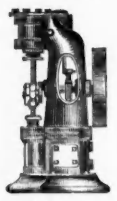

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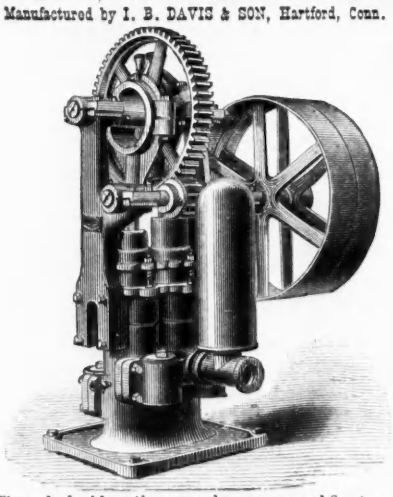

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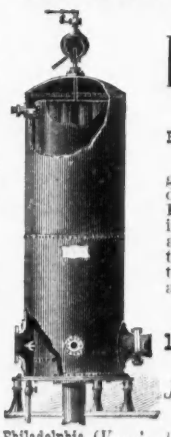

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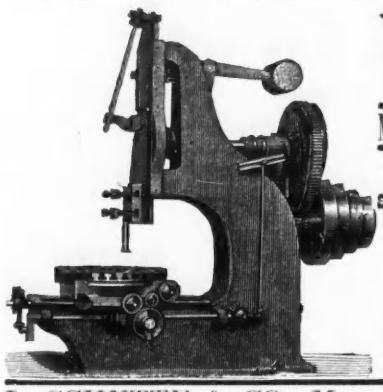

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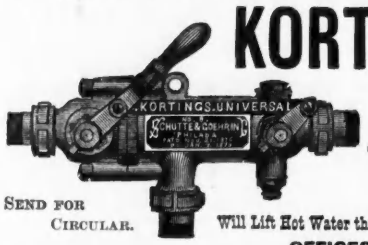

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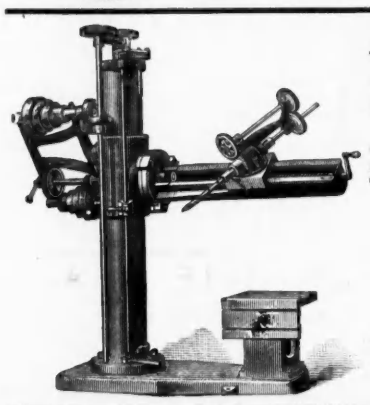

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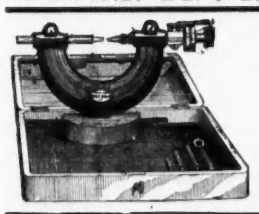

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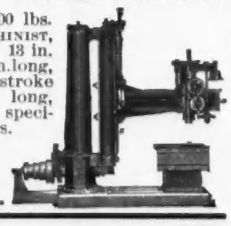

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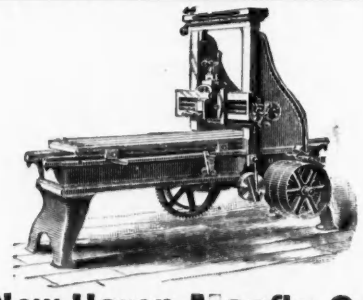

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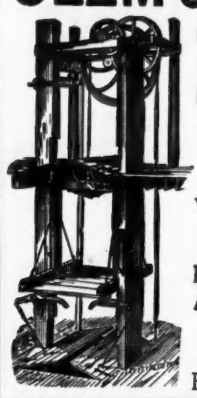

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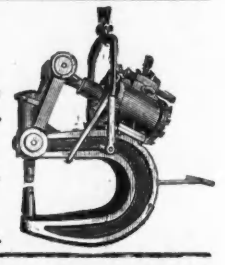

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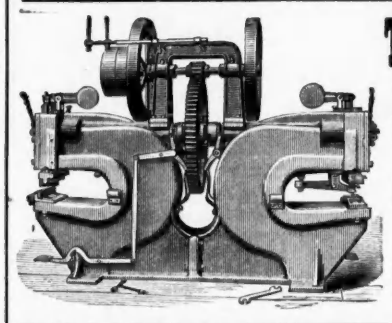

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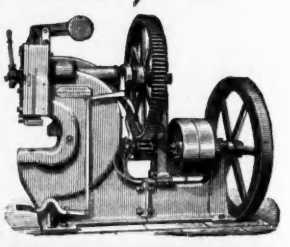

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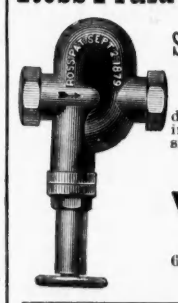

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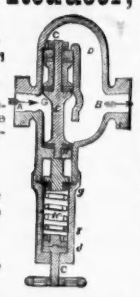

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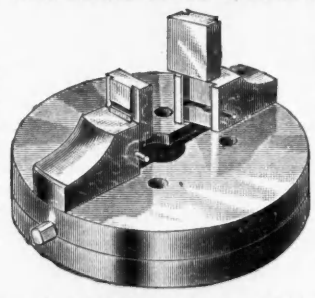

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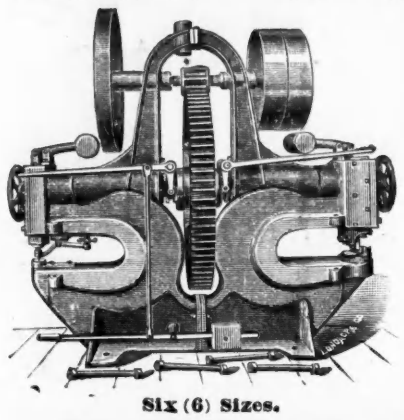

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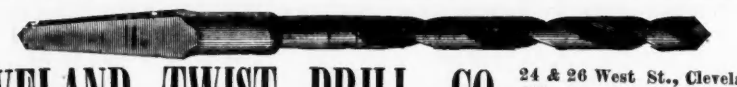

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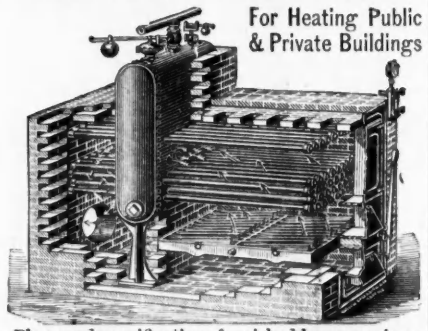

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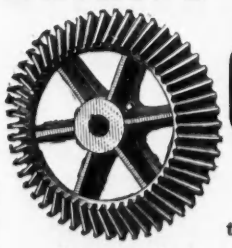

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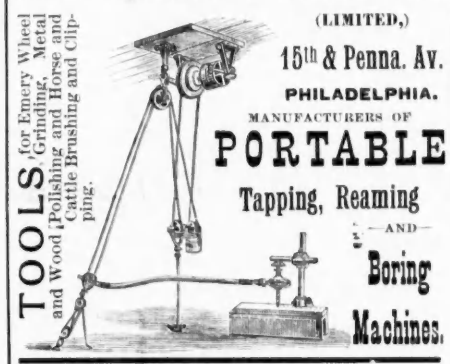

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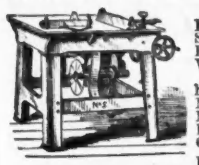

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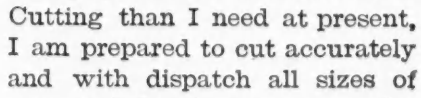

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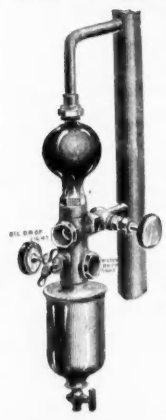

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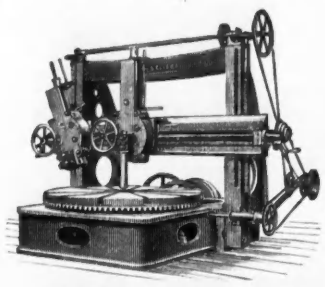

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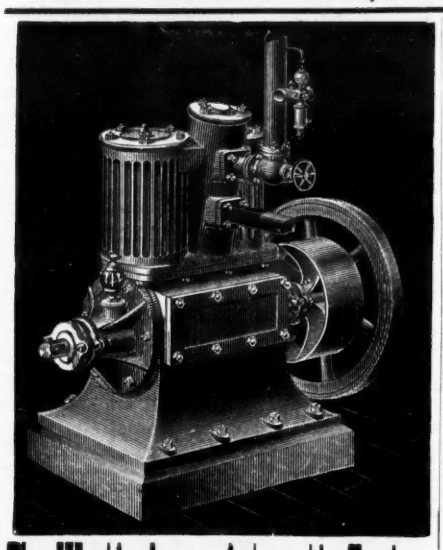

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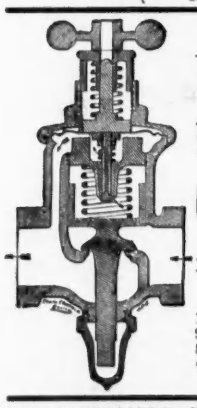

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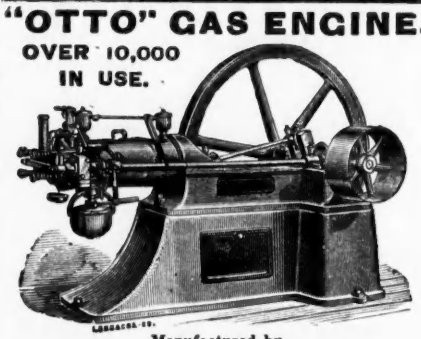

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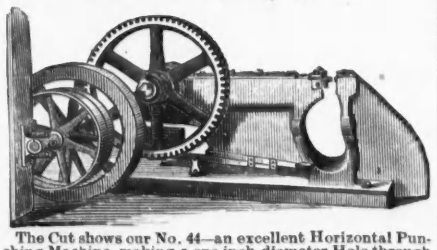

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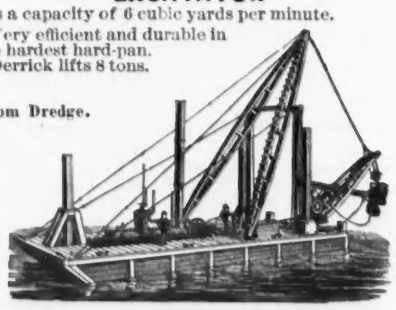

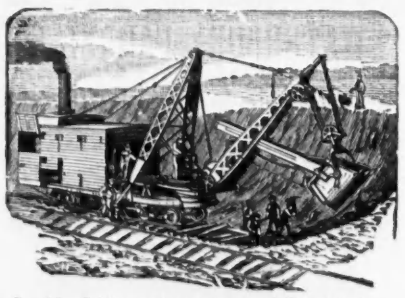

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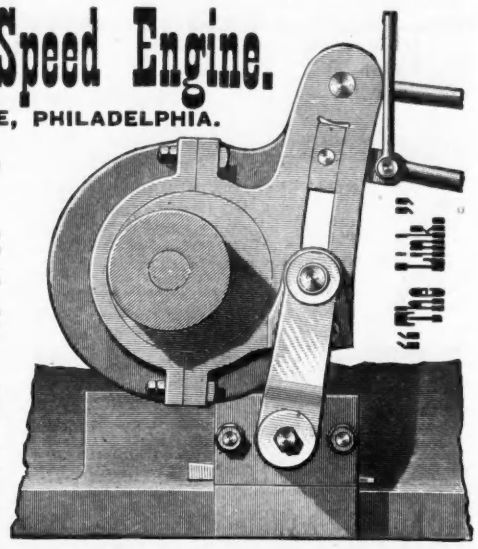

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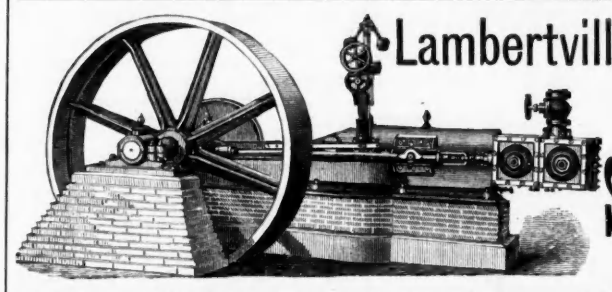

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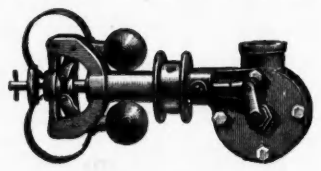

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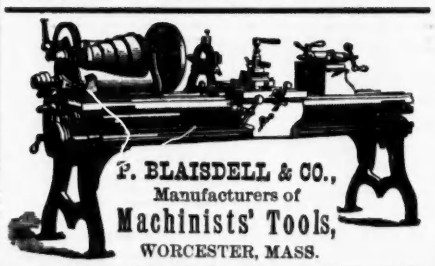

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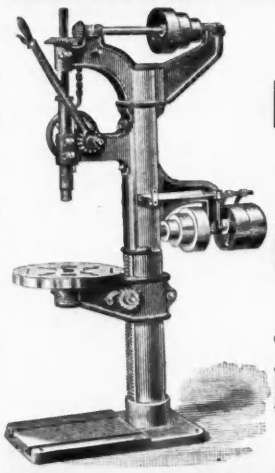

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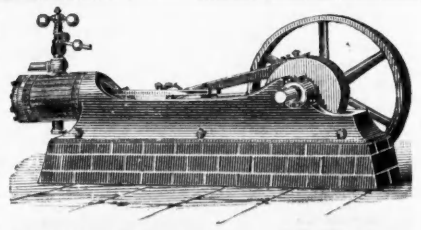

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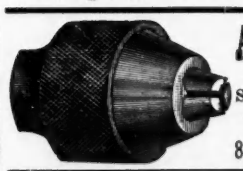

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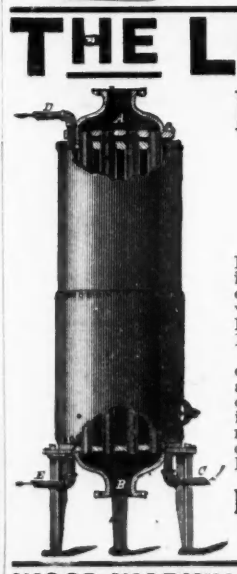

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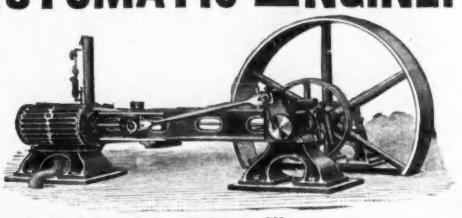

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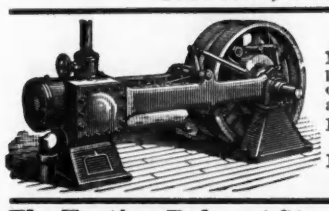

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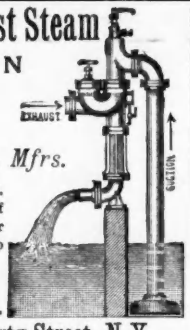

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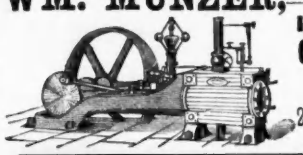

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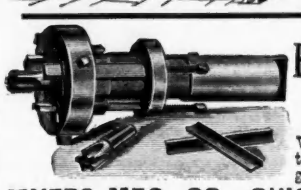

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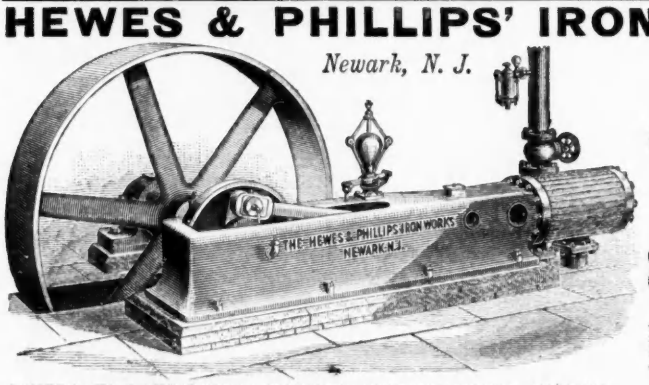

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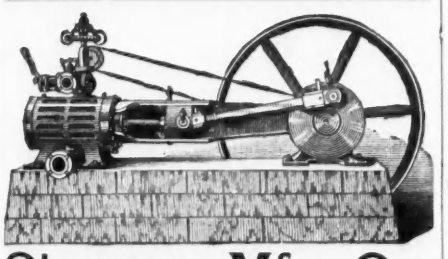

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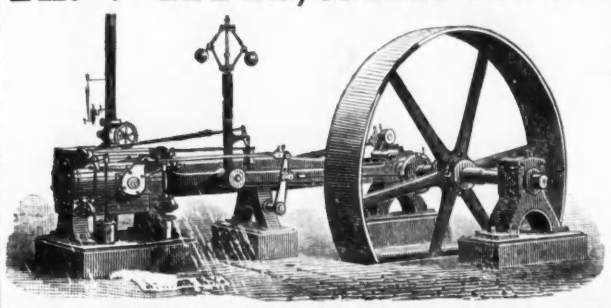

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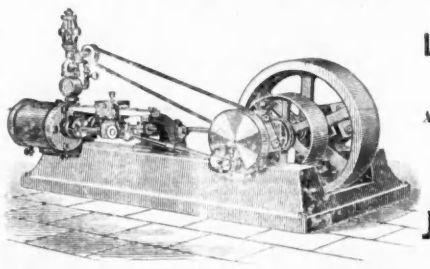

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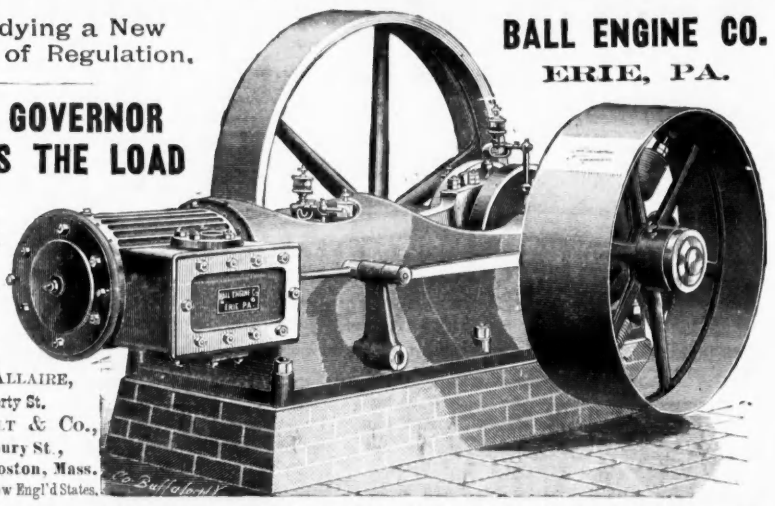

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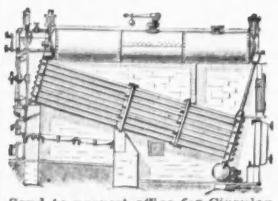

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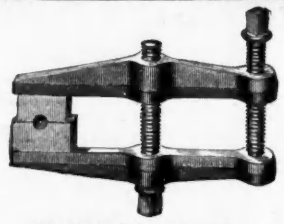

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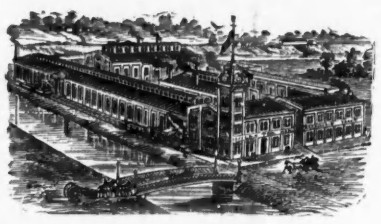

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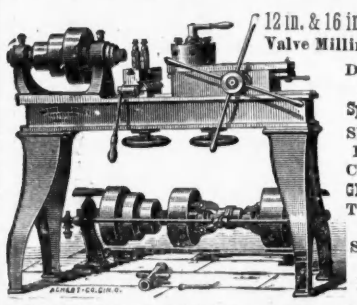

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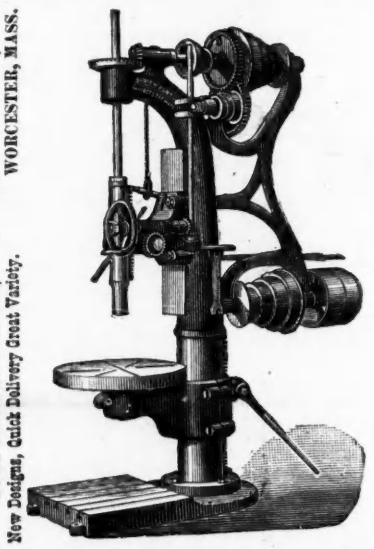

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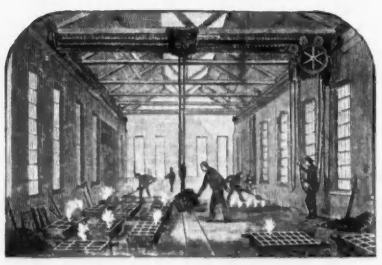

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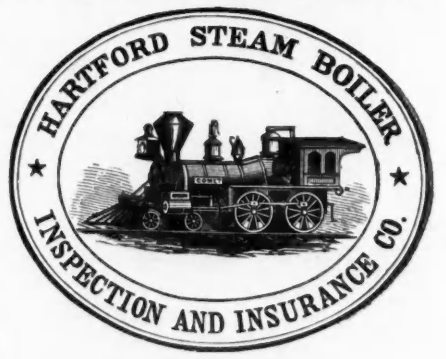

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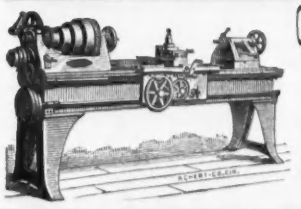

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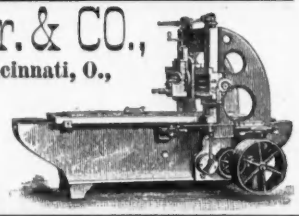

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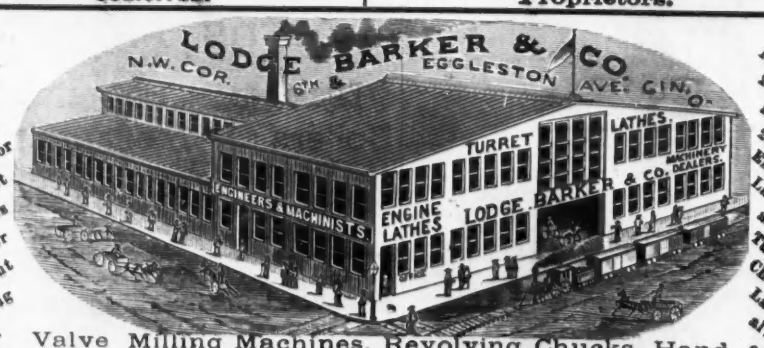

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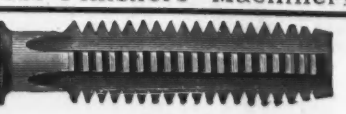

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